

529 Rec'd PCT/PTO 13 JUN 2000

Customized FORM PTO-1390 U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY DOCKET NO. P06780US0/TPS
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		U.S. APPLICATION NO. 09/581422
INTERNATIONAL APPLICATION NO. PCT/EP98/08557	INTERNATIONAL FILING DATE 14 DECEMBER 1998	PRIORITY DATE CLAIMED 15 DECEMBER 1997
TITLE OF INVENTION: A NEW GENE CALLED OLIGOPHRENIN 1, ITS EXPRESSION PRODUCT, AND ...		
APPLICANT(S) FOR DO/EO/US: CHELLY, Jamel et al.		
Applicant herewith submits to the US Designated/Elected Office (DO/EO/US) the following items and other information:		
<input checked="" type="checkbox"/> 1. This is a FIRST submission of items concerning a filing under 35 U.S.C. 371. <input type="checkbox"/> 2. This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 USC 371. <input checked="" type="checkbox"/> 3. This express request to begin national examination procedures (35 USC 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 USC 371(b) and PCT Art. 22 and 39(1). <input checked="" type="checkbox"/> 4. A proper Demand for International Preliminary Examination was made by the 19 th month from the earliest claimed priority date. <input checked="" type="checkbox"/> 5. A copy of the International Application as filed (35 U.S.C. 371 (c)(2)) <input type="checkbox"/> a. is transmitted herewith (required only if not transmitted by the International Bureau). <input checked="" type="checkbox"/> b. has been transmitted by the International Bureau. <input type="checkbox"/> c. is not required, as the application was filed in the United States Receiving Office (RO/US). <input type="checkbox"/> 6. A translation of the International Application into English (35 U.S.C. 371(c)(2)). <input checked="" type="checkbox"/> 7. Amendments to the claims of the International Appln. under PCT Article 19 (35 USC 371 (c)(3)) <input type="checkbox"/> a. are transmitted herewith (required only if not transmitted by the International Bureau). <input type="checkbox"/> b. have been transmitted by the International Bureau. <input type="checkbox"/> c. have not been made; however, the time limit for making such amendments had NOT expired. <input checked="" type="checkbox"/> d. have not been made and will not be made. <input type="checkbox"/> 8. A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)). <input type="checkbox"/> 9. An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)). <input type="checkbox"/> 10. A translation of the annexes to the Int'l Prelim. Exam. Report under PCT Article 36 (35 U.S.C. 371(c)(5)). Items 11. to 16. below concern document(s) or information included: <input type="checkbox"/> 11. An Information Disclosure Statement under 37 C.F.R. 1.97 and 1.98. <input type="checkbox"/> 12. An Assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included <input type="checkbox"/> 13. A First preliminary amendment . <input type="checkbox"/> A Second or subsequent preliminary amendment. <input type="checkbox"/> 14. A substitute specification. <input type="checkbox"/> 15. A change of power of attorney and/or address letter. <input type="checkbox"/> 16. Other items or information: <input type="checkbox"/> Small Entity Statement <input type="checkbox"/> <input type="checkbox"/> A copy of the Notification of Missing Requirements under 35 U.S.C. 371. <input type="checkbox"/> In the event that a petition for extension of time is required to be submitted herewith, and in the event that a separate petition does not accompany this response, applicant hereby petitions under 37 CFR 1.136(a) for an extension of time of as many months as are required to render this submission timely. Any fee is authorized in 17(c).		
Date: 13 June 2000		

4.0 Rec'd PCT/PTO 13 JUN 2000

U.S. APPLICATION NO. (if known) 09/581422		INTERNATIONAL APPLICATION NO. PCT/EP98/08557		ATTORNEY DOCKET NO P06780US0/TPS	
<input checked="" type="checkbox"/> 17. The following fees are submitted:					CALCULATIONS PTO USE ONLY
<input checked="" type="checkbox"/> Basic National Fee (37 CFR 1.492 (a) (1)-(5):					
<input type="checkbox"/> Neither Int'l Prelim. Exam. fee nor Int'l Search fee paid to USPTO				\$ 970	
<input checked="" type="checkbox"/> Search Report has been prepared by the EPO or JPO				\$ 840	
<input type="checkbox"/> No Int'l Prelim. Ex. fee paid to USPTO but Int'l Search fee paid to USPTO				\$ 690	
<input type="checkbox"/> International preliminary examination fee paid to USPTPO				\$ 670	
<input type="checkbox"/> Int'l Prelim. Ex. fee paid to USPTO & all claims satisfied PCT Art. 33(1)-(4)				\$ 96	
ENTER APPROPRIATE BASIC FEE AMOUNT =					\$ 840.00
<input type="checkbox"/> Surcharge of \$130 for furnishing the oath or declaration later than from the earliest claimed priority date (37 CFR 1.492(e)).					<input type="checkbox"/> 20 mos. <input type="checkbox"/> 30 mos. +
					\$
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total Claims	DEFER - 20 =		X \$18 =	\$ DEFER	
Independent Claims	DEFER - 03 =		X \$78 =	\$ DEFER	
<input type="checkbox"/> Multiple Dependent Claim(s) (if applicable)			+ \$260 =	\$ DEFER	
TOTAL OF ABOVE CALCULATIONS =					\$ 840.00
<input type="checkbox"/> Reduction of 1/2 for filing by small entity, if applicable. A Small Entity Statement must also be filed.					\$
SUBTOTAL =					\$ 840.00
<input type="checkbox"/> Processing fee of \$130 for furnishing the English translation later than from the earliest claimed priority date (37 CFR 1.492(f)).					<input type="checkbox"/> 20 mos. <input type="checkbox"/> 30 mos. +
TOTAL NATIONAL FEE =					\$ 840.00
<input type="checkbox"/> Fee for recording the enclosed assignment, accompanied by a cover sheet - \$40 per property					\$
TOTAL FEES ENCLOSED =					\$ 840.00
<i>Amount to be</i>					<i>Refunded</i> \$ <i>Charged</i> \$
<input checked="" type="checkbox"/> a. A check in the amount of \$ 840.00 to cover the above fees is enclosed.					
<input type="checkbox"/> b. Please charge my Deposit Account No. 12-0555 in the amount of \$ to cover the above fees.					
<input checked="" type="checkbox"/> c. The Commissioner is hereby authorized to charge any additional fees required or credit overpayment to Deposit Account No. 12-0555.					
Note: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.					
SEND ALL CORRESPONDENCE TO:			SIGNATURE: <u>Douglas E Jackson</u>		
THOMAS P. SARRO			NAME: DOUGLAS E. JACKSON		
At the address (below) of CUSTOMER NO. 000881.			REG. NO.: 28518		
LARSON & TAYLOR, PLC			PHONE NO.: 703-739-4900		
1199 NORTH FAIRFAX ST.			Date: 13 JUNE 2000		
SUITE 900					
ALEXANDRIA, VA 22314					

007424350

SEQUENCE [L1] LISTING

(1) GENERAL INFORMATION:

(i) APPLICANT:

(A) NAME: Institut National de la Santé et de la
Recherche Médicale
(B) STREET: 101 rue de Tolbiac
(C) CITY: Paris
(E) COUNTRY: FRANCE
(F) POSTAL CODE (ZIP): 75013

(ii) TITLE OF INVENTION: oligophrenin 1 gene and protein

(iii) NUMBER OF SEQUENCES: 27

(iv) COMPUTER READABLE FORM:

(A) MEDIUM TYPE: Floppy disk
(B) COMPUTER: IBM PC compatible
(C) OPERATING SYSTEM: PC-DOS/MS-DOS
(D) SOFTWARE: PatentIn Release #1.0, Version #1.25 (EPO)

(2) INFORMATION FOR SEQ ID NO: 1:

(i) SEQUENCE CHARACTERISTICS:

(A) LENGTH: 1650 base pairs
(B) TYPE: nucleic acid
(C) STRANDEDNESS: double
(D) TOPOLOGY: linear

(ii) MOLECULE TYPE: DNA (genomic)

(vi) ORIGINAL SOURCE:

(A) ORGANISM: Homo sapiens

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 1:

TTTTTCAACC CATGGTGCAT TTAAAGCTCA TTTTGGACAT TTTCCATAA ATTAACCTTA
60

AAGATAAAAA GAGTAAGAAA CAAACTTTC CCCTGAGATG TGGCTACTTA TTTATTTTCA
120

GAGGGCGTTT TCTCATTGCC ATTCTGCTAT ATAGTGTAGT GGTCAAGAGC ACTACCTCTA
180

GAGCCAGCCA GGCTGGGCTC AAGTTCAAGT GCTGCCATTT AACTAGCTGT TTGTCCTTCG
240

GCAAGTCACT TAAACTCTCT TTGACCCAGC TTCTCCATCT TTAAATGGGT ATAATAATAA
300

AACCATCCTC ATAGGGTTGT TTTGAAGATT AGTGAGATGG GCGATAGGTT GTGTGGTGGG
360

TAGAATAATG TTTCTCTCTT CACAGATGTC CATGTCCTGT CCTGAAACCT GTGGCTACGT
420

00443-4400

TATCTTATGT GGCAAAATGA AATTTGCAGA TGTGATTAG GATGATGTGA TGGGGGAGAT
480

TATCCTGTGG ACCCAGTGTA ATCATAAGGG TCCTTAAGGG GAGGCATGAG AATCACAGTG
540

ATGTAGCATG AGAAAGACTT GACTGGCCAG TGCTAGCTTT AAAGACGGAG GAAGGGAGCT
600

ATGAGCCAAA GGATGTGAGC AGCTTGAGCC GGAAAAGGTA AGGAACCAGA TTCTACCCCT
660

AGACTATCTG AAAATGAACA CAACCCTTCT AACATCTTGA TTTGATCCCA GTGAGGCCCA
720

TTTCTGATTT CTGCCTTCTG GAACTGTAGA TTATAACTTT ATGCTGATTT AGGACATCAA
780

GTTTGTGGTA ATTTGTCACA GCAGCAGCAA CAGGACCTAA TTCAGGTGGG TCAGCCACTA
840

TTATTCTATT TACAACCCCC TTCCGTTCTG GCTTTCTTCA CAGGGCAATC TAATGTAAAC
900

ACTTCTGCAG AATTAAAGGG ATCTCTTTGC CCACGCACAA ACTATTTTTT AGTTTTTCGA
960

GCCTCTACCT ACCCTTAGTC TCAAGACAGC TGCCTTTAAG GTAAGCTGCA AGACAATTTA
1020

TAACATCCTA TTCTTAGACT TTCCAATTAC ACATGGAAAA TCATATGCAT TATCGGCGTC
1080

TGCCACAAAA GCCATGCTCT GAGGTCTTAT TCAGGAAAAT ATTAAGTCTG AATTATGGCC
1140

TCCCTTTCTT TGGCAGGGGG CACTGAGCTT CACGGAGACC CTAGAGTAGG AATCAACCCT
1200

TCAGGTGGAA GGCCCAAGGG AATTAGAGCA CTTAGAGCAG GAGACATGGG AAAAGAAAGA
1260

GGAAAAGAAG TTGGTAGGTC CGAAGGAGGC TGGAAAGAGG GGAAGGCAAA AGAATACACA
1320

ACCCAGCCGA ATCATGGGAA GTGAGAGATG GCTTCCTGCA ATCTAGTCTT GCGGGTTCTT
1380

GCTCTAGTTT CGGAAACTTC CCCCAGAGAG TCCAGCGCCG CGCACCTGCC CCTTGGGGCC
1440

GGTCCCTGCG CAGGAGCCTG CGGCAGGCTG GGAATGCCGT TCTGGGAGAG CAGCCTCCCA
1500

GGCGGGGTGG TGGGGAGACT GCAGGGAGGA GTTTTGGGGA GTGCAAACGG AAAGACTACA
1560

TTTCCAGGC CGCCACGCTT TCCAGCTGGA GTCCTAGGGC GCTGACTGCT CCCAGTTTC
1620

CGTAGGGAAG CGCTGGGCTA CCGCGGCTAT
1650

(2) INFORMATION FOR SEQ ID NO: 2:

- (i) SEQUENCE CHARACTERISTICS:
 (A) LENGTH: 1079 base pairs
 (B) TYPE: nucleic acid
 (C) STRANDEDNESS: double
 (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: DNA (genomic)

- (vi) ORIGINAL SOURCE:
 (A) ORGANISM: Homo sapiens

- (ix) FEATURE:
 (A) NAME/KEY: exon 1
 (B) LOCATION: 1..634

- (ix) FEATURE:
 (A) NAME/KEY: exon 2
 (B) LOCATION: 778..935

- (ix) FEATURE:
 (A) NAME/KEY: oligonucleotide
 (B) LOCATION: 727..746

- (ix) FEATURE:
 (A) NAME/KEY: oligonucleotide
 (B) LOCATION: 958..977

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 2:

TGTGCGTCGC GCTCTCGCCC TCCTCTTCCC GCTGCAGTGT CTATGGAGCG AGGCTACGTT
60
TCATTGCCGC CCTGGCTTAA CCCTTCCGGC GCCTAAAAGG ACGGCCGGCC GGCCGGTCCC
120
TTGCACCAGG AAGAAGTCTT AGCAGCCAGC GGGCCCTGGT CAGGAACTC TAAGGTACAA
180
GGAAAACAGT TGAGGAAGGA GCCAGAGCGC TCCGGTTTGG TCCTCGGGCT TCGCTGGGGC
240
GGGGCGCAGG CGTTGGCTTT AAGAAAGGGG AGGGGACAGT GCAATCCGGG TTGCCC GCGG
300
ATTCGGCCAA GGAATCTTCC GCTCGCTCCG GAGCGAGGAG CCTGTAAAGA GGCTGTTCCC
360
AGCTCCAGCT CTAACCTCGC CTACACCTTG GCGGGGCCCA ATGTCACGTT TGCAATTGCT
420
CAGGAAGGAT CCGGCCCGTC TCCGGAGGCA AGTCGGGCTG CGGTTTTTGC TGCTTATCTG
480

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GGAAGGCGAT GCCTAAGGGA CATGCTGCTT GCTAGGCAGC ACCCTGCCGG GATCCGACTG
540

CGATAGTTAG CTCTCCCTGG CCCTGAAGCC ATCGCCGGGG CGCCTGTTCT CTGTCCGGAC
600

CAGCCAGCGC TCCTCAGGAG TCTCACTGAA ACAGGTACCT GTCCTCCAAA GGGACGGAGG
660

CTATGAGCTT CCTTAAGCGG GTCGCGCGCT CAGTCCGTCC CCTCTACTTC CTCTACTGTG
720

CCATTGATGC TCTCGGTCTT TGTGTCTTTC CCCTTTCCCC CTACTCCCGG CCATCAGAAC
780

CATGGGTCAT CCCCCGCTGG AGTTCAGCGA CTGCTACCTG GACAGCCCCG ATTTCCGCGA
840

GAGGCTCAAG TGTTATGAGC AGGAACTGGA GAGGACCAAC AAATTCATCA AAGACGTAAT
900

CAAAGACGGC AACGCGCTTA TCAGCGCTAT GAGAAGTAAG TGCAAGGCTT CGATGAGCTG
960

TTTCTCTGAN CTGGTGTGTC TGGCCTTTAA GCCTTTCCAC ACCACCAGGG GAAGGGAGAT
1020

TGCAGGGTGA CTCCCAGCCC ANATCTCTGA GGCAAATGGG TTTCCCACAC TTGGGGAGT
1079

(2) INFORMATION FOR SEQ ID NO: 3:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 900 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: double
- (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: DNA (genomic)

(vi) ORIGINAL SOURCE:

- (A) ORGANISM: Homo sapiens

(ix) FEATURE:

- (A) NAME/KEY: exon 3
- (B) LOCATION: 403..498

(ix) FEATURE:

- (A) NAME/KEY: oligonucleotide
- (B) LOCATION: 375..394

(ix) FEATURE:

- (A) NAME/KEY: oligonucleotide
- (B) LOCATION: 504..523

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 3:

CTTTGAACTC CACACGTATA AAATGGAAAG CATCTAGTGT ATTGCCATA ATAGGGGTTT
60

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AGGAAATGTG TAAGGAGACC CTCTTAAGAG TATATCTAAG TAGTTTCATG TCTTCCATGC
120

TTTGAGTGGA ACAGGTCAGA GAGGAGAGGT GTTGAGGATA AAAACATGTC CCGTAACTTT
180

TAAGGACTTT ACTGAGATGC CCCATCCTTT CTTCTTGTGA TTTTAGTTGT TCAAACCTTC
240

TTCTACTGCA TATCTAATCT TTTGTTTTAT TTCATTAAAT GCTAGTGCA ACCTGCTCAG
300

AGCACTTACC TTTGGTTTTC TTTTATCTGC TCTTATAGAG ATGAGGAAAT AGATCAAAGC
360

ATAGCATTGT TGAACATTTC TCTTGTTACC CTTCCTTTGC AGATTATTCT TCTGCTGTTT
420

AGAAATTTTC CCAGACGCTG CAGTCATTTC AGTTTGATTT CATTGGAGAC ACTCTGACTG
480

ATGATGAAAT TAACATCGGT AAGTCTTCAG CTACATGTGG TCATATACCT GTTGAGGCAG
540

CCCTGAGACC ATGTAGTCTT TTTGATTTGT GGATACAGAG CACTTGGACA TCTTCATCCA
600

CTGTGGTCCA ATGCCAAGGC CCTGGGAGGT TGATTAGGAA GGATCAGGAA ACTTCCCTG
660

CCAGTCCCAT TTCCTCCTCA CACGACAGCA ATCAAAAGAT ACCCTTAAAC TTCTACTGAG
720

ATTTTGGACT CAGACAGTCT GCAAGCGACC TTTTCTTTAA AGCATAGTTA TTTTCCTAAA
780

GGATATATTA AAAGGGGGAC TTTTTTGTTT TATTTCCCAA AATGGTTGGA GTTAGATTCT
840

TCTAAGGAAT CAAATTTCCC TAGAAAGTGT TAAATTAGCA TTTGTGTGTC TACAACTTAT
900

(2) INFORMATION FOR SEQ ID NO: 4:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 960 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: double
- (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: DNA (genomic)

(vi) ORIGINAL SOURCE:

- (A) ORGANISM: Homo sapiens

(ix) FEATURE:

- (A) NAME/KEY: exon 4
- (B) LOCATION: 483..544

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(ix) FEATURE:
 (A) NAME/KEY: oligonucleotide
 (B) LOCATION: 418..437

(ix) FEATURE:
 (A) NAME/KEY: oligonucleotide
 (B) LOCATION: 551..570

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 4:

TAGAAGAGTA GAAAGTTTGG GAGGGTGGAA AGGGTAATGT TTATTATTTA CTTTGTGTTG
60
ACACTACATT CACCATCCAA TTTAGTTTTT ACAGCAATAG TCTCTGGTTG GTCAGTAGTG
120
GAACAGGGAT CCAAACCTCGT TTCAGGGTTC TATAGCTGCC AATTAATTAC ACAGCAAACC
180
TCTTGCCCCCT TCCCTAATCT TTTAGCTTGT CTATGAAATA AGAGAAATTC TAGCTACTCC
240
TGAGTGGCTG TAAGGATTAA ATAAAATATT AAAGTGATG GGGATTGATA AAAGAGGAAA
300
GAAAAGAAAA GAAACATTCA ACAGGTGCTG AACACCTGCT TTTGTCCTCC GATTTGACAC
360
CTTCCTCTAG TGGCCATGTG GGCATAGGGC ACTGGTCCCT ACTTCCTGTT GCACAGATCT
420
CTATCCATTT GTCTGTCAAG CACCATGATT AATTTGTTTT ACATTTGATT CTCTCCTTCC
480
AGCTGAATCC TTCAAGGAAT TTGCTGAATT GCTCAACGAG GTAGAAAATG AGAGGATGAT
540
GATGGTAAGT CACTAACGCT GTCAGTGAAG CTGAGTTCAT GGGTGATATA GGGGATTTTT
600
CCTTTCCTTT ATGCTTGGAT TGATCCTATA CTATTTTGAT TTCTGTCAGA TAGCTTCTTG
660
GTGCTATAAA AATAGTTAGG TAATAGATCT GGTTATTATG TCTCAAGCTT CCACCCTGAG
720
AGTTTGGCAT TAGATAGAGG GAAATTAACG TGCAAATCCC ATCTGTGTTC ATTTCAGTGA
780
AAAATAATTT CAGTGGATAT TAAACTGGGC CTTTGAACAT GTTGACAGAA ATTGAGGTCT
840
TTAGTGTTTT TAGCCAAATT ATCCATTTGT TAATCTTTAA TTTGTGGAGT AGTTTTACTT
900
TTATAGAGAA AATCAGTAGA AAATAAAGAT AGAACTCATA TACCACCTTT CTCTCTCCCA
960

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(2) INFORMATION FOR SEQ ID NO: 5:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 960 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: double
- (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: DNA (genomic)

(vi) ORIGINAL SOURCE:

- (A) ORGANISM: Homo sapiens

(ix) FEATURE:

- (A) NAME/KEY: exon 5
- (B) LOCATION: 451..522

(ix) FEATURE:

- (A) NAME/KEY: oligonucleotide
- (B) LOCATION: 423..445

(ix) FEATURE:

- (A) NAME/KEY: oligonucleotide
- (B) LOCATION: 553..574

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 5:

TCTGGTTTTA TGGCACAGGC AGGACTGTAA ATGTTTTATC CTAATGCTAT CACTGCACAC
60

TCATTTGCCT CTGATGAAAT GATTTGCACT TGCTGCAATT GTCCTTTTCT TGTATTTGCC
120

ATTCTCTTTC TCTTCTCTTT TTCACCTGTC CTTCAGGTCT CCTGTGTCCT CTGCTGGACA
180

TCACTTCAGA TATTTATCGA TTAAAACTC AGGTCAGACT ATCATTAAAG TTACAGAGAA
240

ATGCCCTCT TATTCTTTCT CCCATTCTT CTCAATGCAT TTGATTTTTC AGAAACAATA
300

TAGAAACAAA CAGTAACAAA ACCCAACAAA TCAGCAAACC ATTTAACATT TTGCAGGTTG
360

GTATATAAAT GAAAATGTAG TAACAAGGAA TCTTGTATCT GAACCTTGTT AACCTAGAAA
420

TTGTTTTGTT TGTTTTTCCT TTTTGTCTAG GTACACAATG CTAGTGATTT GCTGATTAAA
480

CCCTTGGAAT ATTTCCGGAA GGAACAAATA GGCTTCACCA AGGTACATTT TCTGTATATG
540

CATAAGATTT TTTAAAATAG CAATCGAATA GTTGTATGGG CTAATATTCT TCACTTTACA
600

AAGATATGCA CCAATCTGCT GGTGCTTTGC TCTTGGCCTA GTCAGCCTCC TAAACTGTGC
660

AAAATAAATG TTTGTTGTTT ATGTCACCCT GTCTATGGCA TTCTGTTATA GTAGCCTCAG
720

CTAACATGAC AAAGGGGGTG GGGAGGTGGG TGATTAGTTT CTATGAGAAA ATGATCACGA
780

AAGAGAGTAA GAAAATCTAG AATTGGCCTC TGA CTTTGTG GCCAACAGGC TCTGTATCTG
840

TGCATAAGTT TCTTCTTCTT TTGGTGTTTT TGTGTTTTTG TCTGGAAAAC TAGCTAGCTA
900

TCATGTATCA ACTGCCTGCT ATATTGAGCA CTAGGCTAGG TGCTTTACGT TCATTCTTTA
960

(2) INFORMATION FOR SEQ ID NO: 6:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 1020 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: double
- (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: DNA (genomic)

(vi) ORIGINAL SOURCE:

- (A) ORGANISM: Homo sapiens

(ix) FEATURE:

- (A) NAME/KEY: exon 6
- (B) LOCATION: 416..517

(ix) FEATURE:

- (A) NAME/KEY: oligonucleotide
- (B) LOCATION: 388..407

(ix) FEATURE:

- (A) NAME/KEY: oligonucleotide
- (B) LOCATION: 540..559

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 6:

CATTGTAGAT TAACCTTTTC ATGACAAATA TTTACTTCCA TTTGTGTTAT GTCTTCTTCC
60

TTTGTAAGAA AATTTGAATG AGTGTTAAT CTATGTGAAA AATATTGGAG GGAAGAAAAT
120

ATATCTACTG CACAGGCCCT TTTAAGGTAT CATTCTCTAA GGAGCAGCTT CCATAGCTTT
180

CAGCTGTAAA AATAGGGACT GCCATTTCTG CAGGCAGAAT GGT TTGGGGT TATATTTTCAG
240

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GAAGCTGAAA CTGCTGAGAC CAATACAAAG TTAATTCTCC GTTGCTTTTT TTTCTTCCA
300

GGAGCTAGAG GGATTGACCA CCTGAAACCT GACACTATCT CCTTCATTCT CCTTTCTAAG
360

CAGACAGAGT TACAACTACA GACATTTAAT CTTTGCCCTT CTTTCCCACC TTTAGGAGCG
420

GAAAAAGAAA TTTGAAAAGG ATGGTGAGAG GTTTTATTCT TTAAGGATC GGCATTACA
480

CCTGTCTTCA AAAAAGAAAG AATCTCAGTT ACAAGAGGTA TGTTACAAA GCCTGCCCCCT
540

GCCTTCCATT GCTAGCTATG CCTTAGAAAC AGTGTGAATT TTGTACTGCA AGGCTTTTCC
600

CATACCCCGT CTCAGCAGGG AACCTCATGT GATAGTAGCA CTTGTAGTCA AACTGTGGC
660

CTGAGACTCA GAAGCCCTGA ATACTAAGCC AGCTCTTCCA CTAATCAGG GTGTGACCTT
720

GGATAGGATA CTTCTTTCTT TGCCTCATTC CATTATCTGT AAGAAGAGGA GTCGAGAGTC
780

CCTTTCAATT GCAAGTCCAA AATCCATGCG AGGATAAAGT TAACTAGTG TTGTATTTGG
840

TAGAAATCAG GAACAGATCT TCTACTTTTT TCCCTGAGAG ATTCCACAAC CTTTTTTTTT
900

TTTTTTTTTT TTGGTGAGGG GTTAGGGGAA TGTTCTGTTT TGGGACTACT GGTTACCTGG
960

GACTTGCACT GCCTTCAGTT CAAATAAGCT ACCATTCGGT GAGACCCTAC CACATGCCAT
1020

(2) INFORMATION FOR SEQ ID NO: 7:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 1020 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: double
- (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: DNA (genomic)

(vi) ORIGINAL SOURCE:

- (A) ORGANISM: Homo sapiens

(ix) FEATURE:

- (A) NAME/KEY: exon 7
- (B) LOCATION: 464..574

(ix) FEATURE:

- (A) NAME/KEY: oligonucleotide
- (B) LOCATION: 436..458

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(ix) FEATURE:

(A) NAME/KEY: oligonucleotide
(B) LOCATION: 584..603

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 7:

CATTTCTTGT TAAATAAGAC TTGAGACTTG CAGTTCTTTC TGTTGTAATC CCCTCAGTAT
60
TGGCCATAGT AGCATGCTTC TGTTCTTGGG CTTTGGCCCT TGTTAATTTT TTATTCTCTG
120
TATTCATGTC TCTGTAGTGT TTGAGGGAGC AGATTTTCCT CTGACTTCAG TTCTCTGTTG
180
AATATAATAA AATGTGTGGA TTTTACACTT GTTCAGCTTT TTTCTTTTTG TCAGGGTGGG
240
TGTAATGACT TCAAGCTTTT TATGTGTTGG ACCAGAACT GGAATCCTGT ATCAGTCACT
300
TTTTTATCTC TTGGCTTTAG GTTCTCTATT TCTAAAATAA AAGGTAACAT CACTAGTTGG
360
TGGCTAAATG CTCATCTAGC TCTAGCATTG TGTTCAATCC TTAAGTACTG ACTTTCATGA
420
ATGAATATCC CAATATGTAA TGTTTGTTTT CCTTCTTCTA CAGGCAGACC TACAGGTGGA
480
CAAGGAGAGG CACAATTTTT TCGAGTCCTC TCTTGATTAT GTTTATCAAA TCCAGGAAGT
540
TCAGGAGTCC AAGAAGTTCA ATATTGTGGA GCCTGTAAGT TTTCTCTGTT GATGAATGGT
600
CTAAAAATAT TTATCAAATG CCTGGTAAAT GTACAAACTT TGATCATAAA AACAGAATCC
660
CAAAGAACGT GAAGGATAAT CAGTGGAAAT GTCTAGAACG TAGTCTAACT TACGTTTTTC
720
TTGTTCTTTA GTATACTTTT TTTCTCTCTT TCCCCCAAC CCTTTTCTCT CTTTTTCTAT
780
GGCTATTTTC TTTCTCTTTC CTTTTTTTCC TTTCTCTTTC CTCCCCCTT CCGGAATTTT
840
TCTACAACTC TTCCTGTTAC TTTGTTTCCC TCCCTTCCTT CTTCTTGCGC TTTCAGAAGC
900
TTCTGAAAGT CTTTCTCATA TACCAGATAC TATGCTAGGG ACTCATGTCT CTTGCAGTCA
960
GTGACTTCTC ATTCTACTAC TTTTACTTCT GTCTTGTTGA GTTTTTTCCC ATTTACGTT
1020

(2) INFORMATION FOR SEQ ID NO: 8:

- (i) SEQUENCE CHARACTERISTICS:
 (A) LENGTH: 479 base pairs
 (B) TYPE: nucleic acid
 (C) STRANDEDNESS: double
 (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: DNA (genomic)

(vi) ORIGINAL SOURCE:
 (A) ORGANISM: Homo sapiens

(ix) FEATURE:
 (A) NAME/KEY: exon 8
 (B) LOCATION: 244..348

(ix) FEATURE:
 (A) NAME/KEY: oligonucleotide
 (B) LOCATION: 219..239

(ix) FEATURE:
 (A) NAME/KEY: oligonucleotide
 (B) LOCATION: 363..381

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 8:

GCGCCACCAC GGCCAGCTAA TTTTGTATT TTTAGTAGAG ATGGGATTTC ACCATGTTGG
60

TCAGGCTGGT CTCAAACCTC TGACCTCAG ATCTGCCCCG CTCGGCCTCC CAAAGTGCAG
120

GGATTACAGG CATAAGCCAC CACACCCAGC CACACCATGG AGTTTTTTGG TGAGTTCATG
180

TTTCTTTTAT TTAGTTTATT AGAAGATGCT GGTGATAAAG TTATTTTAC ATGTTTCCC
240

TAGGTCTTGG CCTTCTTCA TAGTCTGTC ATTTCTAACA GCCTGACTGT GGAGCTCACA
300

CAGGATTTC TCCCATACAA ACAACAGCTC CAACTCAGTT TACAGAATGT GAGTTTGCAT
360

GTGGATTTTT CTCACCGGTC TTTCCATTCC GATTGAATTT CAGCCCTAGC GACCTTGATT
420

CTTGAATTC TAGGTTACTG CATCCTAGCC AATTTGTTAG AATATACTGG TGTGGATCA
479

(2) INFORMATION FOR SEQ ID NO: 9:

- (i) SEQUENCE CHARACTERISTICS:
 (A) LENGTH: 600 base pairs
 (B) TYPE: nucleic acid
 (C) STRANDEDNESS: double
 (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: DNA (genomic)

(vi) ORIGINAL SOURCE:

(A) ORGANISM: Homo sapiens

(ix) FEATURE:

(A) NAME/KEY: exon 9

(B) LOCATION: 134..263

(ix) FEATURE:

(A) NAME/KEY: oligonucleotide

(B) LOCATION: 108..128

(ix) FEATURE:

(A) NAME/KEY: oligonucleotide

(B) LOCATION: 336..355

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 9:

ACCATTTCTT TTTTGTCTTT GTGGTTGCAC ATGCTGTAAG CAGGGAAAAC TTTGTACTGA
60

GTCTCTGACC AAGAAATACT TTTTCATGAT AATGATGATG ATAATAATGA TTTTCATGAT
120

GATGTCTTGA CAGACAAGAA ATCATTTCTC CAGTACCCGG GAAGAGATGG AAGAACTTAA
180

GAAAAGGATG AAAGAAGCTC CCCAGACATG CAAACTTCCA GGACAGCCAA CTATTGAAGG
240

CTATCTCTAT ACACAAGAGA AATGTGTGTG GGGACATAGG GGTATCCATT GGGTTTCAAT
300

AAGCCAGGAA GTACTGCCAC TTGTCGGCTG TGAATTTTGG GCACCCTTAC TGTTCATAGA
360

CCCCTGATAG CTAAAATTCC CTTGGAACGC AGGCAGGGAA TACTGAAAAC AAAAAAAAAA
420

AAAGGAGAAA CTGAGAGGAA GTTAAAGATT TGTCTTACAA AGGCTGTGTA GTGATAAGAC
480

CTAAGGTTTT CTCTGAGATT CAAAATGGGT ATTATTTGTT CTTAATCCT TCTGATTATT
540

CTTTTGAAA AAAGGGAAGT AGAGGAAAGG AAGTAGAAAA ATAATATTTT TTATACTTAT
600

(2) INFORMATION FOR SEQ ID NO: 10:

(i) SEQUENCE CHARACTERISTICS:

(A) LENGTH: 1020 base pairs

(B) TYPE: nucleic acid

(C) STRANDEDNESS: double

(D) TOPOLOGY: linear

(ii) MOLECULE TYPE: DNA (genomic)

(vi) ORIGINAL SOURCE:
(A) ORGANISM: Homo sapiens

(ix) FEATURE:
(A) NAME/KEY: exon 10
(B) LOCATION: 383..483

(ix) FEATURE:
(A) NAME/KEY: oligonucleotide
(B) LOCATION: 361..380

(ix) FEATURE:
(A) NAME/KEY: oligonucleotide
(B) LOCATION: 492..511

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 10:

AGAGAGATGT GTAGAGTCAT GTACAGGTTA GAAGGGGCAT AACCCAATGA CCAATGACAT
60
GGAACAGTTA TAGAGACAGC AAAGTAAATG ACAATAGTCT CCAGCTTCTG GGATATATGG
120
TGATACAATT TATAGGGAAC ATGGCAGGGA GAGTAGGTTT TGAGCAAGCC AGAAGCAGCT
180
GTGGGAAGCA GTTGGTGAAG GTTAGAATCT CCCTGTGTGC AGTAGGTAGG TGGCTATGGA
240
AGGAGGGCGG TCAGGGCAAG GGCAGGGCTG GATCTGAAGT TTGACTCTGA AGAGCAATGT
300
GTAAATAGCT TCCATCTTAG GGTGACTTC CTATACAGCT AAAATAGTTA TTCTGTCTGC
360
TCACTTTTAC TTGTCCTTGT AGGGGCTTTA GGAATATCCT GGGTGAAATA CTATTGCCAG
420
TATGAGAAAG AGACCAAAAC ACTGACCATG ACGCCTATGG AGCAGAAGCC AGGTGCTAAG
480
CAGGTCAGTT CTTGTTTGCA CCATATTTTT GGAAATGGAT CTATGACTGT TTCTCAGAAA
540
AGAATATATG TTGACCTAGT ATCAAATCAT CAAGTTCATC ACTGTTACGT GAGGCCATGA
600
CTTTATATGT ACACCTTGGC CTAAGTTTGA GTCAGATAGC ACTGAGTTGA GTGAAAAATT
660
TCTCTGTTGA TTAGAGCAAG CCTTTTGAAA GTGCCGGTAG TCTTTCAAAC CAGTTATTTT
720
TACAAGTGCC AGTCACATTG TACAGTCAAC TATGTAAAAA TATGGATGAA TTACTTTTAA
780
GAATGCTCTA CTCTGGATT CTTTAAAATA GCAAGTTTTA AAAATATGAA TTGAATTCCA
840

AAATTCCTTT TTTACAGGAG TGTGTTTATG GCCCACAGTT GGAATAACCG ATACTCACAT
900

TCTATGTACT ACTCAAATAT CTTTAAGCAG TTAATCTCTC TTTTCTGCC CTCCAAACCT
960

TCTCTCACTC CTGAAAATGA CAAGATAAAT TTAACACACT GAAAAAATA GTTTACTTAC
1020

(2) INFORMATION FOR SEQ ID NO: 11:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 294 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: double
- (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: DNA (genomic)

(vi) ORIGINAL SOURCE:

- (A) ORGANISM: Homo sapiens

(ix) FEATURE:

- (A) NAME/KEY: exon 11
- (B) LOCATION: 107..198

(ix) FEATURE:

- (A) NAME/KEY: oligonucleotide
- (B) LOCATION: 81..100

(ix) FEATURE:

- (A) NAME/KEY: oligonucleotide
- (B) LOCATION: 223..242

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 11:

CCCTAGACCA GACGCCTTCC AAGTGACACT GAAGACACTG TAGGAAGCAG AAACAGCTTC
60

TGTGTCTTTT TTTAAAAATT GCCTGTTAAT TCTTGTTTCA TATCAGGGGC CCTTGGACTT
120

AACACTGAAG TACTGTGTGA GAAGGAAGAC GGAGTCTATC GACAAGAGGT TCTGTTTTGA
180

CATAGAAACT AATGAAAGGT AAGCTGTGCC GCTGTGAATT GGCAATGTCC CCACGTGCCA
240

GATGCTTAGC CTGGGTATGT CTTTATTTTT CCTCCGTCAT CCCACGTTGA TGAC
294

(2) INFORMATION FOR SEQ ID NO: 12:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 494 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: double

(D) TOPOLOGY: linear

(ii) MOLECULE TYPE: DNA (genomic)

(vi) ORIGINAL SOURCE:

(A) ORGANISM: Homo sapiens

(ix) FEATURE:

(A) NAME/KEY: exon 12

(B) LOCATION: 211..289

(ix) FEATURE:

(A) NAME/KEY: oligonucleotide

(B) LOCATION: 188..207

(ix) FEATURE:

(A) NAME/KEY: oligonucleotide

(B) LOCATION: 300..319

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 12:

CCACCCCCGC CTCCATGGTT CCCAAAGTTA CTGTTCTGTA AATTGCCTAT TGTTCCTCTT
60

GAGTAAAGA GATTTTGAAA AATTAGTATT CTGTAAGCCT ATGCTTGTTT AGTGTGACAA
120

ACTCCAGGGC AGAGAGGGAC CCTAGATCAC AAGACTCCAT TCTCTCAGTT GAATTTTCTG
180

CTTTATACTT ACCATTTTTT TCCCCCTCAG GCCAGGAACC ATCACTCTGC AGGCCCTTTC
240

AGAAGCTAAC AGAAGGCTAT GGATGGAAGC CATGGATGGG AAAGAACCTG TAAGTTACCT
300

GAACTGGGG CAAACCTCCC CAGCATATGC CAGTGTATGA GTGCCCTCTA GTGGTATCAG
360

TGGGTCTCAN ACAATTAAAT GGTAATGGAT TGTTTAGTCT CAGTTTCTAG GCTGTAAGGA
420

ATTGTTTCCA CATCTCTTAG CAGGTAAGGC AACTGGAGTT CCAGAAAGGT TGAGGGACTT
480

TTCTGAGACC ACCC
494

(2) INFORMATION FOR SEQ ID NO: 13:

(i) SEQUENCE CHARACTERISTICS:

(A) LENGTH: 378 base pairs

(B) TYPE: nucleic acid

(C) STRANDEDNESS: double

(D) TOPOLOGY: linear

(ii) MOLECULE TYPE: DNA (genomic)

(vi) ORIGINAL SOURCE:

09581422.112100

(A) ORGANISM: Homo sapiens

(ix) FEATURE:

(A) NAME/KEY: exon 13
(B) LOCATION: 212..245

(ix) FEATURE:

(A) NAME/KEY: oligonucleotide
(B) LOCATION: 166..189

(ix) FEATURE:

(A) NAME/KEY: oligonucleotide
(B) LOCATION: 259..278

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 13:

GGCATGAGCC ACCACGCCTG GCCTGTTCAA GATTTTCTA GCAATCTTGG CAAAGCAATT
60

ATGTTTAGCC CACTTGGCTA TCTTTTAAAC ATCCTGGAGT TTCTAATCAT TTTTAATGCC
120

TATCTGGGGA AAGATATTTA ATATTATGTT CTCTGTTTTT CTATATTGAT TGACAATAGC
180

CATGGATCTT TCTGTTTATC TTCTTTTGTA GATCTACCAC AGCCCTATAA CAAAACAGCA
240

AGAAAGTGAG TCACTTAAGT TTTTGGTCTA CTAGCATTAT AACTGCCAG CTGTCCGATT
300

CATAGTAAAT ACCATCATTG ATGATGTGTA CTAATAACGC AAGTCTGAAT ATGGATGCCT
360

TTGTGTGAAA TAAAATTC
378

(2) INFORMATION FOR SEQ ID NO: 14:

(i) SEQUENCE CHARACTERISTICS:

(A) LENGTH: 393 base pairs
(B) TYPE: nucleic acid
(C) STRANDEDNESS: double
(D) TOPOLOGY: linear

(ii) MOLECULE TYPE: DNA (genomic)

(vi) ORIGINAL SOURCE:

(A) ORGANISM: Homo sapiens

(ix) FEATURE:

(A) NAME/KEY: exon 14
(B) LOCATION: 172..234

(ix) FEATURE:

(A) NAME/KEY: oligonucleotide
(B) LOCATION: 133..152

(ix) FEATURE:

09581432.11200

(A) NAME/KEY: oligonucleotide
(B) LOCATION: 250..269

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 14:

AAAATGTTAA ACCTCCCCTG AAAAAATGAC TCTTCCATT TAAGGGTGAC TAGAAATGAG
60

CAACTAAAAA CCCTTAGCTC TCTCAATGCA GTCCCTTTGC ATGGTCATTA AATGTTTAAT
120

AGGTGACACC TGTTGCAGCA GGATCTAACT CTTTTCCTTT GCTTGAAACA GTGGAGCTAA
180

ATGAAGTGGG CTTCAAGTTT GTCAGGAAGT GCATCAATAT TATTGAGACC AAAGGTAAGA
240

TCTGAACCAT AGTCTTGCCA TTGTCTGAAT CTCGTCCTC TGATTTTATC CTGGGCAATT
300

TCTCTGAAGT AGCGTTTTAG GAATGAAGAC TGTTTATAAA GCTTGTGTAG TAGATGCAAG
360

CTAGAAAATT TCAGAAAATT CTAAACTAGT GGT
393

(2) INFORMATION FOR SEQ ID NO: 15:

- (i) SEQUENCE CHARACTERISTICS:
(A) LENGTH: 436 base pairs
(B) TYPE: nucleic acid
(C) STRANDEDNESS: double
(D) TOPOLOGY: linear

(ii) MOLECULE TYPE: DNA (genomic)

(vi) ORIGINAL SOURCE:
(A) ORGANISM: Homo sapiens

(ix) FEATURE:
(A) NAME/KEY: exon 15
(B) LOCATION: 207..281

(ix) FEATURE:
(A) NAME/KEY: oligonucleotide
(B) LOCATION: 151..170

(ix) FEATURE:
(A) NAME/KEY: oligonucleotide
(B) LOCATION: 293..315

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 15:

AGATTAATGA GGGTTTGGTA CACTCCAAAT GAAAGGATGG ATAATTTGGA GAGATGCTGT
60

AGGACTATTC CCCTGTTACA GGAAGGCTG GAGAACTTGG AGTATGTAGT GTGACCCCTT
120

09581422-112100

ATTAACCTGA TTTTTCCTC CACTAGGGAT CAAGACAGAA GGGTTGTACC GCACTGTGGG
240

AATTCTTATT GGGAGTACTT TATGTGTTAC AAAGAAATGT GACTGGAAGA GAAAGGAGAC
360

ACTGCTAAAA TGTGGTAGAA TAGTTGAAAA AAGTATTTTC TAAAGTAAAA CATAACATA
420

CTTGCCCACC CTGGGC
436

(2) INFORMATION FOR SEO ID NO: 16:

(i) SEOUENCE CHARACTERISTICS:

- (A) LENGTH: 547 base pairs
(B) TYPE: nucleic acid
(C) STRANDEDNESS: double
(D) TOPOLOGY: linear

(ii) MOLECULE TYPE: DNA (genomic)

(vi) ORIGINAL SOURCE:

- (A) ORGANISM: Homo sapiens

(ix) FEATURE:

- (A) NAME/KEY: exon 16
(B) LOCATION: 270..354

(ix) FEATURE:

- ```
(A) NAME/KEY: oligonucleotide
(B) LOCATION: 221..244
```

(ix) FEATURE:

- ```
(A) NAME/KEY: oligonucleotide
(B) LOCATION: 363..382
```

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 16:

ACCCCAGTNA TNTGATGAAT CTAAGAAGAG TNGATNTTGT TTGTTTCAGTT TTTTCTTGTT
60

GTGTGAATTG GATAGATTAC TTTNTTATTT CTTATATGGC AGACCAGAAT GCAGTCATGT
120

TTTTGAAATA TCAAAGATTT GCTTCTTCTA AAGTTTGGAT NTCTTAAAAA CTACTTAGGG
180

240 TNATATACTT TGT TTTTCTT TTAAAGAGG GAAAATGTAA GATTTTTTTG ATGATTAAC

TAATCCCACT AAGCTGTAGG GCTCAGGAAC TTCAGCCTTG CTGTCCCCAG AACTAAGAA
300

CCAATACCCA GCTGCTTTNT TCCCAAAGCA ACTGACAATT TTCATTCATT TCAGGAATCT
360

TTCTGAACCT GTCATGACCT ATAGACTTCA CAAAGAGCTG GTCTCTGCTG CCAGTAAGTA
420

TTTATGTTAC TAATTAAGTG TGTGTCCTA GTTCTTAAT GTTTACTGCA ATAAGCCTAG
480

AAAATTGTTT GAGGGGAAGT GATTGAGGGC ACAGAAACCT AAAACACATA CACAAATTAT
540

GCACAACTGC CAAATGAAAG TATTCTTGCT TGCTGTCTAA CTCAANAATT CTATTATTTT
600

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601

(2) INFORMATION FOR SEQ ID NO: 18:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 387 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: double
- (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: DNA (genomic)

(vi) ORIGINAL SOURCE:

- (A) ORGANISM: Homo sapiens

(ix) FEATURE:

- (A) NAME/KEY: exon 18
- (B) LOCATION: 80..185

(ix) FEATURE:

- (A) NAME/KEY: oligonucleotide
- (B) LOCATION: 25..44

(ix) FEATURE:

- (A) NAME/KEY: oligonucleotide
- (B) LOCATION: 218..237

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 18:

GTGCATATAT ATGTGAGAAT TTTGCTCAAT CCAGTAGCCC AGAAAGCCAA ACCATTTATC
60

TCTTACTGTT CTATCCCAGA GTCTGACAAC CTGGATTACC GCCTAGGAGC TATTCCTCC
120

CTGGTATATA AGCTACCAGA AAAGAACCGA GAGATGCTGG AACTTCTGAT AAGACACTTG
180

GTCAAGTAAG TAACTGCTGG ATTTTCAGAA AAAGTTCCTA TTAGAGGACT GGCCCATGTG
240

00001423.12400

GTTGGACTAC ACAGAACTG CCTCTCAGCT CTTTCAGCCC CAGCCCTTAA GTGCTTCCTT
300

GGAAGCTGAA TGCTCTGTGA GGAAGGCTAT TTTGCCTTGA CCCATGTACA TATCCTCTTA
360

GAGTCATCAT GCATGTGGAT TGTCTCA
387

(2) INFORMATION FOR SEQ ID NO: 19:

- (i) SEQUENCE CHARACTERISTICS:
 (A) LENGTH: 460 base pairs
 (B) TYPE: nucleic acid
 (C) STRANDEDNESS: double
 (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: DNA (genomic)

(vi) ORIGINAL SOURCE:
 (A) ORGANISM: Homo sapiens

(ix) FEATURE:
 (A) NAME/KEY: exon 19
 (B) LOCATION: 79..238

(ix) FEATURE:
 (A) NAME/KEY: oligonucleotide
 (B) LOCATION: 51..70

(ix) FEATURE:
 (A) NAME/KEY: oligonucleotide
 (B) LOCATION: 252..271

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 19:

AACAGCACCT AAAACAGTCT TGGTTGTAAG GGGATACTGG AGCAAATTTT GTTAATCTTG
60

CCCCTTTTCT TCTGGCAGTG TGTGTGAGCA CAGCAAAGAG AATCTTATGA CCCCCTCCAA
120

CATGGGAGTA ATCTTTGGGC CCACCCTGAT GAGAGCTCAG GAGGACACTG TGGCCGCCAT
180

GATGAACATC AAATTCCAGA ACATAGTGGT GGAAATACTA ATCGAGCACT TTGGCAAGGT
240

ATGCATTTTC TATTCTCACT ACCTGTCTTC CAAACATGTG ACACTTTCCC CCAACTGCCT
300

TTTAGTGCTG TGTCTTCCTC CTTGGCTCAC GTTGACAGTG AAAGGAAATC CCATTATGAC
360

ACAATGACAT TTAATGGCAA CTCTGACCCT GGGAAATTCA TTCATTGAGC AACATTGCT
420

TAAGCTTATA ACTATATTAT TTTCAGACAC CATGCTAAAT
460

0069143-1-100

(2) INFORMATION FOR SEQ ID NO: 20:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 512 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: double
- (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: DNA (genomic)

(vi) ORIGINAL SOURCE:

- (A) ORGANISM: Homo sapiens

(ix) FEATURE:

- (A) NAME/KEY: exon 20
- (B) LOCATION: 230..377

(ix) FEATURE:

- (A) NAME/KEY: oligonucleotide
- (B) LOCATION: 206..225

(ix) FEATURE:

- (A) NAME/KEY: oligonucleotide
- (B) LOCATION: 383..402

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 20:

TCTTCCAAAC TGAGAAGTGC CAGGTTNTGT GCCTTGAGCA TAGTAGGAGN TACNTAAACA
60

TTTACCTGTA GNTAGAGTGA TTAAGAAAAT CTCTGATTCT TTGAGTCATG TTAGTATTCA
120

CGTNACAAAC TCTAGATATA AGGCCAACAA GCATCAANTG GTGGGTAGCA TTCAGAAGAC
180

AAAAANTTGA TNTAANTATT CTNTAGATAT NTTCTTCTT TNTCCACAGA TCTATTTAGG
240

TCCACCTGAG GAAAGCGCTG CACCGCCAGT GCCTCCGCCT CGGGTGACAG CAAGAAGGCA
300

CAAACCAATC ACGATTTCAA AGCGCTTGCT GCGAGAAAGG ACGGTTTTCT ATACTTCTTC
360

CCTGGATGAA AGCGAAGGTC AGTACTNAGG TTCTCCTTTA GCTTCTGAAT GGTGATTAGA
420

CACNNAGNAN GATATCNAAT GGCTCAAGCG GTGGCATCAC CATTTNTCTC TCTATAAAAG
480

TANACCTTTC CTGNCTCCTG AACTTAAAAG CA
512

(2) INFORMATION FOR SEQ ID NO: 21:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 841 base pairs

(B) TYPE: nucleic acid
(C) STRANDEDNESS: double
(D) TOPOLOGY: linear

(ii) MOLECULE TYPE: DNA (genomic)

(vi) ORIGINAL SOURCE:

(A) ORGANISM: Homo sapiens

(ix) FEATURE:

(A) NAME/KEY: exon 21

(B) LOCATION: 185..508

(ix) FEATURE:

(A) NAME/KEY: oligonucleotide

(B) LOCATION: 151..170

(ix) FEATURE:

(A) NAME/KEY: oligonucleotide

(B) LOCATION: 511..530

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 21:

GGCTTTACAT GAACTGGGAA GGGTAGAGAA TGATTTTGTG GGATATAGTT GGTGTGTC
60

ACAGTGACAT AACTGCTTTG AAAATGTATA CAAATTTTCA AAATTAAGTA TGTATGCATG
120

TATCAAAATG AAAAGGTTTT AAAAGTTATC ATTAATCTTC CCTNTTGGCA CCAACTTTTC
180

CTAGATGAAA TCCAACATCA AACACCGAAT GGTACTATCA CCAGCAGCAT AGAACCCCCC
240

AAGCCACCAC AACACCCCAA ACTACCTATT CAGAGGAGTG GGGAACTGA TCCTGGGAGG
300

AAGTCCCCAA GCAGGCCTAT TTTGGATGGC AAGTTGGAGC CCTGCCCAGA GGTGGACGTG
360

GGGAAGTTGG TGTCTAGGCT GCAGGATGGA GGGACCAAGA TCACCCCAA GGCCACCAAT
420

GGACCCATGC CAGGCTCTGG GCCCACCAAG ACCCCCTCTT TCCACATAAA GAGACCAGCT
480

CCCCGGCCCC TGGCCCCACCA CAAGGAGGGT AAGTGCTTGG GAATCCCATG GGAGCCAGAG
540

CTGACCCTAA CTACTTTTCA CCTTGAGATC CTTCTGAGTT TGGAGATATA TTTAAGTGA
600

AATATGTTCC AGTTTACTAC CACTAATATT GGAACAGTGG GCAAGATCAC AATAATCAGT
660

CACAATAATC ACTAGAATGT AAGCTCCATG AGGGCCGGGA TTTTTCCTT GTTTGTGGA
720

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CCTCTATATC CCAAGTGCTA TGTGCCTGGC ACTGTACTAA TTGCTGATAT ACTATTTCTT
780

ATCCTCACAA TCCCACTGTA AAGAATGTAT TATTCTTAAT ATTTTCTTTT TTTTTTTTTT
840

T
841

(2) INFORMATION FOR SEQ ID NO: 22:

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 615 base pairs
- (B) TYPE: nucleic acid
- (C) STRANDEDNESS: double
- (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: DNA (genomic)

(vi) ORIGINAL SOURCE:

- (A) ORGANISM: Homo sapiens

(ix) FEATURE:

- (A) NAME/KEY: exon 22
- (B) LOCATION: 320..485

(ix) FEATURE:

- (A) NAME/KEY: oligonucleotide
- (B) LOCATION: 294..313

(ix) FEATURE:

- (A) NAME/KEY: oligonucleotide
- (B) LOCATION: 496..515

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 22:

TTTAATCCTC CCACTATCTC TGTAAGATAA TATATTGTGG ATCTTTATTA TATAGCTGGG
60

GAAACTGAGA CTTAGGGAAT GGATATGACA CACCCAAGAT ATNTGAACT CCAGAGCTGG
120

GGTTCAAATA TAGACTTTCT GAAGGGACAG TTGCCAGAAA AATTACAAA AAAAAAAAAA
180

ATAGCCAGAG TTGTTAGTCA CCAAGAAGAA ATGGAGGCCA AGGAAGTTGG CCCAGGTAAC
240

TTCATATTG GGTGCCTGCT CATGAGTAGT GTTCTGTTTG GCTAACCATC CAAGTTCCTG
300

GTATCATTTT CTCTCCAGG GGATGCTGAC AGTTTCAGCA AAGTGCGGCC TCCAGGAGAA
360

AAGCCAACCA TCATCCGCCC CCCAGTGAGG CCCCAGATC CTCCCTGCCG GGCAGCTACT
420

CCCCAAAAGC CAGAACCAA GCCAGATATT GTGGCTGGCA ATGCGGGGGA AATCACATCA
480

004424860

TCTGTGTCAG TAGGGTTGTA CCTCAAAGTT GACTGAAGTC CTGTACTAGG CCACTAGGAA
540

TGCTTTCAGG ATCACCATAT TAAGGGTATA CAGTGCACAG CCCTGGGGCA TCCTTCACTT
600

TATAGTCTAG GGAAA
615

(2) INFORMATION FOR SEQ ID NO: 23:

- (i) SEQUENCE CHARACTERISTICS:
 (A) LENGTH: 475 base pairs
 (B) TYPE: nucleic acid
 (C) STRANDEDNESS: double
 (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: DNA (genomic)

(vi) ORIGINAL SOURCE:
 (A) ORGANISM: Homo sapiens

(ix) FEATURE:
 (A) NAME/KEY: exon 23
 (B) LOCATION: 211..261

(ix) FEATURE:
 (A) NAME/KEY: oligonucleotide
 (B) LOCATION: 179..198

(ix) FEATURE:
 (A) NAME/KEY: oligonucleotide
 (B) LOCATION: 271..291

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 23:

AATGGGGATA AAGAGTGTCA GCTATGGCCT TAGGGGTGCC TATGGGCTCT GGGCCATTTC
60

ACATTTGTAT GTGTAGGGCC TTTGCCAGCA AAGGCAGGGG CTGGCATTGG TGTCCCATCT
120

GGTTCAGAGT CTCCTGTCCT TTCTGTTGGC CATTGGTTCT CACGTGTATA CCAAAGCAAC
180

TTATGGGACT TGGTTGGCTT CTGTTTGCAG GGTGGCTTCC AGGACCAGGT TTTTGTAAAC
240

AGCTTCCCGG AAAACAGGAA GGTAAGATAT GGAGGTGACA AAAGAAAAAC CAAATCGCCT
300

TTTAATAACT GCATCCTTAG CATACAATTG TGCTCACTCT AACATCTTTC TCTTTTGT
360

TCTCTACAGC TCTGTCTCTG TCTGTCACTT TCTCTTCCCC AATTCTGTCT CTCCATCCCT
420

ATCTGTCTGT CACCTGTTCA CCTGTGTGTC TATTTGTTTC TCTCATATTC TTTT
475

(2) INFORMATION FOR SEQ ID NO: 24:

- (i) SEQUENCE CHARACTERISTICS:
 (A) LENGTH: 238 base pairs
 (B) TYPE: nucleic acid
 (C) STRANDEDNESS: double
 (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: DNA (genomic)

(vi) ORIGINAL SOURCE:
 (A) ORGANISM: Homo sapiens

(ix) FEATURE:
 (A) NAME/KEY: exon 24
 (B) LOCATION: 115..156

(ix) FEATURE:
 (A) NAME/KEY: oligonucleotide
 (B) LOCATION: 65..84

(ix) FEATURE:
 (A) NAME/KEY: oligonucleotide
 (B) LOCATION: 165..184

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 24:

CCATTTTTCA AATGGCCTCT TTAGCACTGG CCTAGAAGTG TCCCCCATTC CCCCAATTTA
60

CCTTTCCAGT CCTGATTTCT AGAATCTTAG TGAAACGTCT TTCTTTATCC ACAGTTCTCA
120

AGGCAGACTT CCTGGAGATG AAAGTTGAGG CTACAGGTAT GCAGTCCCCA TCCCTGATTA
180

CAAAATCTTG TTCCACATAA GCCTTCATTA CGGGATCTGA TATTTTGAGG ACTGGAAT
238

(2) INFORMATION FOR SEQ ID NO: 25:

- (i) SEQUENCE CHARACTERISTICS:
 (A) LENGTH: 4504 base pairs
 (B) TYPE: nucleic acid
 (C) STRANDEDNESS: double
 (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: DNA (genomic)

(vi) ORIGINAL SOURCE:
 (A) ORGANISM: Homo sapiens

(ix) FEATURE:
 (A) NAME/KEY: exon 25
 (B) LOCATION: 1..4235

09584422.42400

(ix) FEATURE:

(A) NAME/KEY: polyA_site
(B) LOCATION: 4236..4241

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 25:

GTTTAAAG CCTGGCCTC AGAGGACCCT TTCCAGGTTC TGAAAGAGTC TTTCTTCTTC
60
AAACCTTTGT GTGCGGAGTC ATTTTGTGTT GAAGAGCAGC TCCTTCCTAG CCTTGCACTT
120
TCAGACTCTC TCTGGGAGGC CATAAAATAA GGAGCATATG TCCTAGACAG GTGTTTATAT
180
CTCCTTTGTA TTCTGTCTTC ATCCCCTCAG AAGGTCTGTT TTGAGTTCCT ATAACACTGT
240
GAAGAGCTGG ACTCCCTCAA GCCAGACTCT GCCAAAACCA AGATATCCAC TTACCTGAGT
300
TGAAGAGGGG AGCTCAGTTT TCAACTCTTC CCTGAACTTC CTGCTTCCTC AGAGGGCCAT
360
TGAAGTCTGA GAGATTGTTGG GCTAAAGACT GATCTCAGGG GTCTTACCTT GAACTGAAGG
420
CCACTTGAGT TGGGGCCATT GCTTACCTTG GTTGAAGGG AATAGAAATG TTTGCTGAAC
480
ATTGGAGAAT CTCAACATGT CTCCTACTGA GGATATGGAC ACTGGTGCCA TGTCAGCGCT
540
CTGGTGCTGC AGTATGTTGC CAAGAGCCCG TCTGCTCCTG CGAGGCTATG AGTGGGATGA
600
GTGATGCCCC CACAGCACCT CCATGTGGAC TTAGGAAGGT GGCCTTCCTG CTGTTACATG
660
CAGCCACTTA GGACAAATCT GCAAAGCATG TTTTGCATGT AAAAGCCTAG GTCTATTTGG
720
ATTATTCTTT CTCCTTTTTT TTGACAGCTT CCTGTCAAGC AATCAAGAAA CAAACAAAAG
780
CTGAACACAT TTCCTTTTAA AAAAAGGAGA CTGTGTTTGG TCCTGTAGGA GTTCTATTTT
840
GGGGTCAAAT GCTAGAAAAA TTGTTAAGGT GGATTGAGGC CAGGCAGCTG TCACTGCTGC
900
TTCATGTTTG CCTTCTGCAC ATAACTCTT TTATCTCCTG AAAAAGCAG TTCTTAACCC
960
AGTGTCCATG GACTCAGAAA CTCCATGATG CCCCTGAGAT GGTATGCACA ATTCCATGAC
1020

006644-1000

AATATGCCCT TTCTGGGGAG ATAGTCCATA ATGTTCTGCT AAATTTCAAA TGGGCTCGTG
1080

ACCCAAAAAA GTCAAGAACC ACAGCACTTG AGTTAAAATA CTCTTTTAC AATCCATATA
1140

AGCCCTTGAT TGGAAGGGCT TTTCAAAATC ATTTAGTCTA ACAACTGCCC AGTTTCCAGT
1200

CGGGGGAAGT GAGGCAGAGC AAGGTAGTGA TCACACCAGT ACAAGATTTC AGGTCCCAGG
1260

CTCCTATGCA AGTTTTTTTT CCCCATATA TCACACTTAT TTAGCAAGGG ACCTTGTGGT
1320

TTGTGGCTTT AGTGGCCATC ATTTCTGGGG GTTGGCTTTT ACCCTTTTTC TTGAATATTT
1380

GCCACCAAGT GAAAAATGTT AGGACATAAA CCCTTGCCAG GTCCCTTTCA TTTGCTATCT
1440

CTATTATTGG AAAGGACCTA AAAATTGGTG TAATGGGGCA GAAATCTGAG GAATGGACAT
1500

TTCTAATTCC TGTTTGTTGA AGGGAAGTTG CTGGAAAGAG CATCAGTACT TGTTTCTATG
1560

CAGATGCCTG GGCCGTAGCT TGTCTGTAGC GTCTGTATAA TTATAATGTT GCCCAGTGTG
1620

AGGGAAAGAG CTTTCCTACT TGCCTCTTC TACCAAGGCC CTGTTAGTGC ACTGATTATA
1680

GTACTGACAG ATAAAGCCTA GATGAGAGAG ATAGAGAGTG AGTACATGCA CACTCATGTG
1740

CAAACCCACT CAGAGATGCA TTTGGAACAG TGCTACTGAA AGGCAGTAGT CATTTTCAAG
1800

ACTGAATTCC AACATGGTT TATTGGTGAG TTAGGAACAT GTAAGGCCAA GTACACTGAG
1860

AGCCTTTTTG AAAGTAATTG AGTGGAAACT TGATGCCATT CTAAATCAAG GCATATCCAG
1920

GTGGCCCGGT TTGAACTCAC TCCACTGTAC CCAGTCTCAA AGGCCAGGTT GCTAAGAAAC
1980

CAGGAGTAAA AGAGTCAAGT GACCATCATT TCACCTGCTG CTTGCCCCCA ATAGTAGTCT
2040

CTGTGAGGCC TTAGTGACCT CACCTAGGAA GTGATTTTTG AGCCCTTGTT TCAGGGCTGT
2100

GGCCTCCCTG CTCTATCCTG AATAAAGCAG ACAGGTGTGC AGATTTTGGC CATGAAAGCA
2160

TGGCTAATAG GGCCACAGTC CCTTTAAAGA AACATGGTTT GACTCTGGTT TTCTTGGGGG
2220

09584422.112100

AAAATACCAC AATCACCGAT GCAAACATTG GAAGATTATT GAGAGCCCTA GAAAGCTGCT
2280

GTGATCCCAG TAGAAAATAT GTCCCAGAAA TGTCATGAGA TTGCTGTGTG TTGCCTGGGA
2340

CACAGATCAA GGGCCTATCT TGGAGAGCTG GGGACCAGCA GTCTGCCTGG AGGCCAGGGA
2400

GCAGTGGCTG AGTAGCTCTG CCTTTGCTCT GGTCTATACC TTAAGAATGC CAAAGAATGA
2460

ATTTCAACGC CTGCCTTTGG CACTCTGACT TAAAGTGCAA AAAGCTTCTG TGGCGAGGCA
2520

TGCTATCATG GAATGAGACT GGCTTGCCCT AGGCTTAATG GATGGGCAGT CATTTTGCAG
2580

AGGCTATGGG AAGAGGGTGA TAATAGAAGA GTGGCAGCTA TAGGAAATTA TCAACATACC
2640

TTGGCCAGCA AGTTAGAGAA TCTGGCAATG GATGAACTGA AAGTGATGAA CTGGCAGGGA
2700

TAACAAAGAA CCTAACATTT ATTAAGCACG TATTTATTAA CTGCTCAGTG TTTCATATTC
2760

ATGCAAGTAT TCTCATTTTA CAGAGAAAGA AATTATGGCC CAGGGGGCTA AAGTAAACAA
2820

CTCAAGGGCA CATAGAAAGT AAATAAAAGG ACTGTGATTT GAATCCAGGC CACTCTTAGC
2880

CCATGCTGTT TTCCCTTTGC CACACTGTGG TAGGTGTTTG AACAGAGGCC ACATTACTAG
2940

AGTTGGCATG ACTCTTGACT CTTGCCTGCC TAACAAAATA TTGAAAGGCA AACATTTGAA
3000

GGAGGGAGGG GGTGCAGGTT CAGTTTATAT GGAAATGCAA ACTGGGCTGG AAGATATTCC
3060

TGAGTTAGGC TTTCTCTTCA TATTCAGCTT GCACATTTGG TAATGTTTTT AAAATGATCA
3120

TCTAATTTTA TTTTGTGAAG TGAAGGATTT GTGTTTTAGT TGGCAGTTGT TAAGTCCTTG
3180

GCTTGCCATT TTTCAAAAAG TAAAAAGGTC CTCACAGGTG TCTCCATACT TCGCCAAGGT
3240

TGTAGCATGG GCAGTTTCAG TTTCAGCCTA AGAGACTGGT GACATCCACA AATGCAGTTT
3300

TAGAAGCAGA AAAGGTCTTG GTGCCTCTGC AGTACTTGAT GTATTGGGGT CAAATCTCTA
3360

CAAATTTTTT TGTGGTGATA GCAAAATCAA GAGATGGCTT ACAAAAAGAA ATATTGAATT
3420

09584432-1400

TTTATTTTGT AAGTTTTTGT TTTTAAAAG GTTGGGGGTG TTCAGCCACT GAGGGACAAA
3480

ACTTAGCATC TAATTTCAAT TATAGTGTC TGCAGAGTAT TTCTAAAGTA ATTGGTTATC
3540

ATGGGAAAGT ATTCTCTTTT CAAGAAGTTC TTTGATTCTG TAATAACTAG AACAAATAAA
3600

GTAGTAAAAG AAGAAATAGT TCTGTGACTA GGAAAAAATT GCTTTTGAGA GAACATAGAT
3660

CAATTATACT ACTTCTAAGG TAGCTGCAGA TAAGTGGCCT TGACACATTA CAAGCCTGGA
3720

AAAAAACATC AGAAATAATA AAAAATTTCA GAGAGAATCA AGATACCTTT TTTTCTCTT
3780

TTTTTTCTT TTTTTTATTA TACTCTAAGT TTTAGGGTAC ATGTGCACAT TGTGCAGGTT
3840

AGTTACATAT GTATACATGT GCCATGCTGG TCGCTGCAC CCACTAATGT GTCATCTAGC
3900

ATTAGGTATA TCTCCAGTG CTATCCCTCC CCCCTCCCC GACCCACCA CAGTCCCCAG
3960

AGTGTGATAT TCCCCTTCCT GTGTCCATGT GATCTCATTG TTCAATTCCC ACCTATGAGT
4020

GAGAATATGC GGTGTTTGGT TTTTGTCT TCGGATAGTT TACTGAGAAT GATGTTTCC
4080

AATTTTCATCC ATGTCCCTAC AAAGGATATG AACTCATCAT TTTTATGGC TGCATAGTAT
4140

TCCATGGTGT ATATGTGCCA CATTTTCTTA ATCCAGTCTA TCATTGTTGG ACATTGGGT
4200

TGGTTCCAAG TCTTTGCTAT TGTGAATAGT GCCGCAATAA ACATACGTGT GCATGTGTCT
4260

TTATAGCAGC ATGATTTATA CTCATTTGGG TATATACCCA GTAATGGGAT GGCTGGGTCA
4320

AATGGTATTT CTAGTTCTAG ATCCCTGAGG AATCGCCACA CTGACTTCCA CAATGGTTGA
4380

ACTAGTTTAC AGTCCAACCA ACAGTGTAAG AGTGTTCTTA TTTCTCCGCA TCCTCTCCAG
4440

CACCTGTTGT TTCCTGACTT TTTAATGATT GCCATTCTAA CTGGTGTTGA GATGATATCT
4500

CATA
4504

(2) INFORMATION FOR SEQ ID NO: 26:

- (i) SEQUENCE CHARACTERISTICS:
 (A) LENGTH: 3101 base pairs
 (B) TYPE: nucleic acid
 (C) STRANDEDNESS: single
 (D) TOPOLOGY: linear

(ii) MOLECULE TYPE: cDNA

- (vi) ORIGINAL SOURCE:
 (A) ORGANISM: Homo sapiens

- (ix) FEATURE:
 (A) NAME/KEY: CDS
 (B) LOCATION: 639..3047

- (ix) FEATURE:
 (A) NAME/KEY: oligonucleotide
 (B) LOCATION: 152..172

- (ix) FEATURE:
 (A) NAME/KEY: oligonucleotide
 (B) LOCATION: 586..606

- (ix) FEATURE:
 (A) NAME/KEY: oligonucleotide
 (B) LOCATION: 641..663

(xi) SEQUENCE DESCRIPTION: SEQ ID NO: 26:

TGTGCGTCGC GCTCTCGCCC TCCTCTTCCC GCTGCAGTGT CTATGGAGCG AGGCTACGTT
60

TCATTGCCGC CCTGGCTTAA CCCTTCCGGC GCCTAAAAGG ACGGCCGGCC GGCCGGTCCC
120

TTGCACCAGG AAGAAGTCTT AGCAGCCAGC GGGCCCTGGT CAGGAAACTC TAAGGTACAA
180

GGAAAACAGT TGAGGAAGGA GCCAGAGCGC TCCGGTTTGG TCCTCGGGCT TCGCTGGGGC
240

GGGGCGCAGG CGTTGGCTTT AAGAAAGGGG AGGGGACAGT GCAATCCGGG TTGCCCCGGG
300

ATTCGGCCAA GGAATCTTCC GCTCGCTCCG GAGCGAGGAG CCTGTAAAGA GGCTGTTCCC
360

AGCTCCAGCT CTAACCTCGC CTACACCTTG GCGGGGCCCA ATGTCACGTT TGCAATTGCT
420

CAGGAAGGAT CCGGCCCCGTC TCCGGAGGCA AGTCGGGCTG CGGTTTTTGC TGCTTATCTG
480

GGAAGGCGAT GCCTAAGGGA CATGCTGCTT GCTAGGCAGC ACCCTGCCGG GATCCGACTG
540

CGATAGTTAG CTCTCCCTGG CCCTGAAGCC ATCGCCGGGG CGCCTGTTCT CTGTCCGGAC
600

05581423 11400

CAGCCAGCGC TCCTCAGGAG TCTCACTGAA ACAGAACCAT GGGTCATCCC CCGCTGGAGT
660

TCAGCGACTG CTACCTGGAC AGCCCCGATT TCCGCGAGAG GCTCAAGTGT TATGAGCAGG
720

AACTGGAGAG GACCAACAAA TTCATCAAAG ACGTAATCAA AGACGGCAAC GCGCTTATCA
780

GCGCTATGAG AAATTATTCT TCTGCTGTTT AGAAATTTTC CCAGACGCTG CAGTCATTTT
840

AGTTTGATTT CATTGGAGAC ACTCTGACTG ATGATGAAAT TAACATCGCT GAATCCTTCA
900

AGGAATTTGC TGAATTGCTC AACGAGGTAG AAAATGAGAG GATGATGATG GTACACAATG
960

CTAGTGATTT GCTGATTAAA CCCTTGGAAT ATTTCCGGAA GGAACAAATA GGCTTCACCA
1020

AGGAGCGGAA AAAGAAATTT GAAAAGGATG GTGAGAGGTT TTATTCTTTA CTGGATCGGC
1080

ACTTACACCT GTCTTCAAAA AAGAAAGAAT CTCAGTTACA AGAGGCAGAC CTACAGGTGG
1140

ACAAGGAGAG GCACAATTTT TTCGAGTCCT CTCTTGATTA TGTTTATCAA ATCCAGGAAG
1200

TTCAGGAGTC CAAGAAGTTC AATATTGTGG AGCCTGTCTT GGCCTTCTT CATAGTCTGT
1260

TCATTTCTAA CAGCCTGACT GTGGAGCTCA CACAGGATTT CCTCCCATAC AAACAACAGC
1320

TCCAACCTCAG TTTACAGAAT ACAAGAAATC ATTTCTCCAG TACCCGGGAA GAGATGGAAG
1380

AACTTAAGAA AAGGATGAAA GAAGCTCCCC AGACATGCAA ACTTCCAGGA CAGCCAACTA
1440

TTGAAGGCTA TCTCTATACA CAAGAGAAAT GGGCTTTAGG AATATCCTGG GTGAAATACT
1500

ATTGCCAGTA TGAGAAAGAG ACCAAAACAC TGACCATGAC GCCTATGGAG CAGAAGCCAG
1560

GTGCTAAGCA GGGGCCCTTG GACTTAACAC TGAAGTACTG TGTGAGAAGG AAGACGGAGT
1620

CTATCGACAA GAGGTCTGT TTTGACATAG AAATAATGA AAGGCCAGGA ACCATCACTC
1680

TGCAGGCCCT TTCAGAAGCT AACAGAAGGC TATGGATGGA AGCCATGGAT GGGAAAGAAC
1740

CTATCTACCA CAGCCCTATA ACAAACAGC AAGAAATGGA GCTAAATGAA GTGGGCTTCA
1800

DRAFT 1.1.99

AGTTTGTCTCAG GAAGTGCATC AATATTATTG AGACCAAAGG GATCAAGACA GAAGGGTTGT
1860

ACCGCACTGT GGGCAGCAAT ATTCAGGTTT AGAAGCTGCT GAATGCCTTT TTTGATCCTA
1920

AATGCCCAGG AGATGTTGAT TTTCATAATA GTGACTGGGA CATTAAGACA ATCACCAGCT
1980

CCTTGAAATT CTACCTCAGG AATCTTTCTG AACCTGTCAT GACCTATAGA CTTCACAAAG
2040

AGCTGGTCTC TGCTGCCAAG TCTGACAACC TGGATTACCG CCTAGGAGCT ATTCACTCCC
2100

TGGTATATAA GCTACCAGAA AAGAACCGAG AGATGCTGGA ACTTCTGATA AGACACTTGG
2160

TCAATGTGTG TGAGCACAGC AAAGAGAATC TTATGACCCC CTCCAACATG GGAGTAATCT
2220

TTGGGCCCCAC CCTGATGAGA GCTCAGGAGG ACACTGTGGC CGCCATGATG AACATCAAAT
2280

TCCAGAACAT AGTGGTGGAA ATACTAATCG AGCACTTTGG CAAGATCTAT TTAGGTCCAC
2340

CTGAGGAAAG CGCTGCACCG CCAGTGCCTC CGCCTCGGGT GACAGCAAGA AGGCACAAAC
2400

CAATCACGAT TTCAAAGCGC TTGCTGCGAG AAAGGACGGT TTTCTATACT TCTTCCCTGG
2460

ATGAAAGCGA AGATGAAATC CAACATCAAA CACCGAATGG TACTATCACC AGCAGCATAG
2520

AACCCCCCAA GCCACCACAA CACCCCAAAC TACCTATTCA GAGGAGTGGG GAAACTGATC
2580

CTGGGAGGAA GTCCCCAAGC AGGCCTATTT TGGATGGCAA GTTGGAGCCC TGCCCAGAGG
2640

TGGACGTGGG GAAGTTGGTG TCTAGGCTGC AGGATGGAGG GACCAAGATC ACCCCAAAGG
2700

CCACCAATGG ACCCATGCCA GGCTCTGGGC CCACCAAGAC CCCCTCTTTC CACATAAAGA
2760

GACCAGCTCC CCGGCCCTG GCCCACCACA AGGAGGGGGA TGCTGACAGT TTCAGCAAAG
2820

TGCGGCCTCC AGGAGAAAAG CCAACCATCA TCCGCCCCC AGTGAGGCC CCAGATCCTC
2880

CCTGCCGGGC AGCTACTCCC CAAAAGCCAG AACCAAAGCC AGATATTGTG GCTGGCAATG
2940

CGGGGGAAAT CACATCATCT GTGGTGGCTT CCAGGACCAG GTTTTTTGAA ACAGCTTCCC
3000

095443 11400

AAAAGCCTTG GCCTCAGAGG ACCCTTTCCA GGTCTGAAA G
3101

(i) SEQUENCE CHARACTERISTICS:

- (A) LENGTH: 802 amino acids
- (B) TYPE: amino acid
- (C) STRANDEDNESS: single
- (D) TOPOLOGY: linear

(vi) ORIGINAL SOURCE:
(A) ORGANISM: Homo sapiens

Met 1	Gly	His	Pro	Pro 5	Leu	Glu	Phe	Ser	Asp 10	Cys	Tyr	Leu	Asp	Ser 15	Pro
Asp	Phe	Arg	Glu 20	Arg	Leu	Lys	Cys	Tyr 25	Glu	Gln	Glu	Leu	Glu 30	Arg	Thr
Asn	Lys	Phe 35	Ile	Lys	Asp	Val	Ile 40	Lys	Asp	Gly	Asn	Ala 45	Leu	Ile	Ser
Ala	Met 50	Arg	Asn	Tyr	Ser	Ser 55	Ala	Val	Gln	Lys	Phe 60	Ser	Gln	Thr	Leu
Gln 65	Ser	Phe	Gln	Phe	Asp 70	Phe	Ile	Gly	Asp	Thr 75	Leu	Thr	Asp	Asp	Glu 80
Ile	Asn	Ile	Ala	Glu 85	Ser	Phe	Lys	Glu	Phe 90	Ala	Glu	Leu	Leu 95	Asn	Glu
Val	Glu	Asn	Glu 100	Arg	Met	Met	Met	Val 105	His	Asn	Ala	Ser	Asp 110	Leu	Leu
Ile	Lys	Pro 115	Leu	Glu	Asn	Phe	Arg 120	Lys	Glu	Gln	Ile	Gly 125	Phe	Thr	Lys
Glu	Arg 130	Lys	Lys	Lys	Phe	Glu 135	Lys	Asp	Gly	Glu	Arg 140	Phe	Tyr	Ser	Leu
Leu 145	Asp	Arg	His	Leu	His 150	Leu	Ser	Ser	Lys	Lys 155	Lys	Glu	Ser	Gln	Leu 160
Gln	Glu	Ala	Asp	Leu 165	Gln	Val	Asp	Lys	Glu 170	Arg	His	Asn	Phe	Phe 175	Glu
Ser	Ser	Leu	Asp 180	Tyr	Val	Tyr	Gln	Ile 185	Gln	Glu	Val	Gln	Glu 190	Ser	Lys

Lys Phe Asn Ile Val Glu Pro Val Leu Ala Phe Leu His Ser Leu Phe
 195 200 205
 Ile Ser Asn Ser Leu Thr Val Glu Leu Thr Gln Asp Phe Leu Pro Tyr
 210 215 220
 Lys Gln Gln Leu Gln Leu Ser Leu Gln Asn Thr Arg Asn His Phe Ser
 225 230 235 240
 Ser Thr Arg Glu Glu Met Glu Glu Leu Lys Lys Arg Met Lys Glu Ala
 245 250 255
 Pro Gln Thr Cys Lys Leu Pro Gly Gln Pro Thr Ile Glu Gly Tyr Leu
 260 265 270
 Tyr Thr Gln Glu Lys Trp Ala Leu Gly Ile Ser Trp Val Lys Tyr Tyr
 275 280 285
 Cys Gln Tyr Glu Lys Glu Thr Lys Thr Leu Thr Met Thr Pro Met Glu
 290 295 300
 Gln Lys Pro Gly Ala Lys Gln Gly Pro Leu Asp Leu Thr Leu Lys Tyr
 305 310 315 320
 Cys Val Arg Arg Lys Thr Glu Ser Ile Asp Lys Arg Phe Cys Phe Asp
 325 330 335
 Ile Glu Thr Asn Glu Arg Pro Gly Thr Ile Thr Leu Gln Ala Leu Ser
 340 345 350
 Glu Ala Asn Arg Arg Leu Trp Met Glu Ala Met Asp Gly Lys Glu Pro
 355 360 365
 Ile Tyr His Ser Pro Ile Thr Lys Gln Gln Glu Met Glu Leu Asn Glu
 370 375 380
 Val Gly Phe Lys Phe Val Arg Lys Cys Ile Asn Ile Ile Glu Thr Lys
 385 390 395 400
 Gly Ile Lys Thr Glu Gly Leu Tyr Arg Thr Val Gly Ser Asn Ile Gln
 405 410 415
 Val Gln Lys Leu Leu Asn Ala Phe Phe Asp Pro Lys Cys Pro Gly Asp
 420 425 430
 Val Asp Phe His Asn Ser Asp Trp Asp Ile Lys Thr Ile Thr Ser Ser
 435 440 445
 Leu Lys Phe Tyr Leu Arg Asn Leu Ser Glu Pro Val Met Thr Tyr Arg
 450 455 460
 Leu His Lys Glu Leu Val Ser Ala Ala Lys Ser Asp Asn Leu Asp Tyr
 465 470 475 480
 Arg Leu Gly Ala Ile His Ser Leu Val Tyr Lys Leu Pro Glu Lys Asn
 485 490 495
 Arg Glu Met Leu Glu Leu Leu Ile Arg His Leu Val Asn Val Cys Glu
 500 505 510

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His Ser Lys Glu Asn Leu Met Thr Pro Ser Asn Met Gly Val Ile Phe
 515 520 525
 Gly Pro Thr Leu Met Arg Ala Gln Glu Asp Thr Val Ala Ala Met Met
 530 535 540
 Asn Ile Lys Phe Gln Asn Ile Val Val Glu Ile Leu Ile Glu His Phe
 545 550 555 560
 Gly Lys Ile Tyr Leu Gly Pro Pro Glu Glu Ser Ala Ala Pro Pro Val
 565 570 575
 Pro Pro Pro Arg Val Thr Ala Arg Arg His Lys Pro Ile Thr Ile Ser
 580 585 590
 Lys Arg Leu Leu Arg Glu Arg Thr Val Phe Tyr Thr Ser Ser Leu Asp
 595 600 605
 Glu Ser Glu Asp Glu Ile Gln His Gln Thr Pro Asn Gly Thr Ile Thr
 610 615 620
 Ser Ser Ile Glu Pro Pro Lys Pro Pro Gln His Pro Lys Leu Pro Ile
 625 630 635 640
 Gln Arg Ser Gly Glu Thr Asp Pro Gly Arg Lys Ser Pro Ser Arg Pro
 645 650 655
 Ile Leu Asp Gly Lys Leu Glu Pro Cys Pro Glu Val Asp Val Gly Lys
 660 665 670
 Leu Val Ser Arg Leu Gln Asp Gly Gly Thr Lys Ile Thr Pro Lys Ala
 675 680 685
 Thr Asn Gly Pro Met Pro Gly Ser Gly Pro Thr Lys Thr Pro Ser Phe
 690 695 700
 His Ile Lys Arg Pro Ala Pro Arg Pro Leu Ala His His Lys Glu Gly
 705 710 715 720
 Asp Ala Asp Ser Phe Ser Lys Val Arg Pro Pro Gly Glu Lys Pro Thr
 725 730 735
 Ile Ile Arg Pro Pro Val Arg Pro Pro Asp Pro Pro Cys Arg Ala Ala
 740 745 750
 Thr Pro Gln Lys Pro Glu Pro Lys Pro Asp Ile Val Ala Gly Asn Ala
 755 760 765
 Gly Glu Ile Thr Ser Ser Val Val Ala Ser Arg Thr Arg Phe Phe Glu
 770 775 780
 Thr Ala Ser Arg Lys Thr Gly Ser Ser Gln Gly Arg Leu Pro Gly Asp
 785 790 795 800
 Glu Ser

007271 22478550

" A new gene called oligophrenin 1, its expression product, and the diagnostic and therapeutic applications thereof".

The present invention relates to the identification of a new gene, called oligophrenin 1, and its expression product, as well as to the diagnostic and therapeutic applications of these nucleotide and peptide sequences.

5 A major challenge for human genetics is the identification of new causes of mental retardation, which, although present in about 3 % of individuals, is unexplained in over half of all cases. X-linked mental retardation is acknowledged to be a major cause of severe learning difficulties. Surveys have shown an excess of males over females with severe mental retardation and later studies suggested that the excess was the result of an X-linked condition. X-linked mental retardation (XLMR) is a vastly heterogeneous group of disorders which can be roughly categorized as syndromic (MRXS) or non specific (MRX). Families with syndromic disorders usually have a quite distinct phenotypic presentation whereas families with non specific disorders present no distinctive somatic features. Despite recent advances in identifying genes such as FMR1(Verkerk et al., 1991), FRAXE (Knight et al., 1993 ; Gecz et al., 1996), L1-CAM (Vits et al., 1994), FGD1 and XH2 (Gibbons et al., 1995), involved in MRXS conditions, so far no gene significantly involved in MRX has yet been identified or cloned. Compilation of the literature and McKusick's catalogue data revealed at least 95 X-linked disorders in which mental retardation appears as the main feature. Of these 95, 40 have been regionally mapped on the X chromosome by conducting linkage studies using DNA markers in single large families or in a collection of families with the same XLMR syndrome. Several loci appear to be located in the proximal Xq region. However, it is impossible to evaluate how many MR genes there are in reality, partly because of the broad localisation and the presence of several overlaps between intervals of assignment. Thus, fine mapping and identification of genes implicated in nonspecific X-linked MR essentially depend on thorough investigation of molecular abnormalities such as balanced translocation, inversion or contiguous gene deletion associated with MR.

Bienvenu *et al.* (1997) have recently reported a molecular cytogenetic investigation of an X;12 balanced translocation observed in a female affected with a mild mental retardation and have localised the breakpoint in Xq12.

5 The authors of the present invention have now cloned the gene responsible for MRX, which they have called the oligophrenin 1 gene.

In order to define the genomic structure of this gene, the authors of the present invention constructed and investigated a cosmid/phage contig that covers the gene. Determination of exon-intron boundaries was performed
10 through sequence comparison between cDNA clones and genomic DNA, which led to the identification of 25 exons.

The authors of the present invention have thus isolated and characterized the oligophrenin 1 transcripts. Said transcripts contain an open-reading frame (ORF) which is encoded by exon 2 to exon 24. This ORF is
15 2406 bases long and encodes a protein of 802 amino acids, called the oligophrenin 1 protein.

A subject of the present invention is thus an isolated nucleic acid having a sequence selected from the group consisting of sequence SEQ ID n°
20 1 to SEQ ID n° 25, and a homologous nucleotide sequence thereof.

SEQ ID n° 1 represents the 5' fragment of the genomic DNA of the human oligophrenin 1 gene.

SEQ ID n° 2 to SEQ ID n°25 represent fragments of the genomic DNA of the human oligophrenin 1 gene including exons as shown in table 1.

Table 1 : identification of the sequences

Sequence Identification	exon included in the fragment of the genomic DNA of the oligophrenin 1 gene
SEQ ID n° 2	exon 1 and exon 2
SEQ ID n° 3	exon 3
SEQ ID n°4	exon 4
SEQ ID n°5	exon 5
SEQ ID n°6	exon 6
SEQ ID n°7	exon 7
SEQ ID n°8	exon 8
SEQ ID n°9	exon 9
SEQ ID n°10	exon 10
SEQ ID n°11	exon 11
SEQ ID n°12	exon 12
SEQ ID n°13	exon 13
SEQ ID n°14	exon 14
SEQ ID n°15	exon 15
SEQ ID n°16	exon 16
SEQ ID n°17	exon 17
SEQ ID n°18	exon 18
SEQ ID n°19	exon 19
SEQ ID n°20	exon 20
SEQ ID n°21	exon 21
SEQ ID n°22	exon 22
SEQ ID n°23	exon 23
SEQ ID n°24	exon 24
SEQ ID n°25	exon 25

SEQ ID n° 26 represents the cDNA fragment corresponding to
 5 the common open-reading frame (ORF).

A subject of the present invention is also an isolated nucleic acid
 having a sequence selected from the group consisting of exon 1 to exon 25 as
 identified in the sequence listing and in table 2, and a homologous nucleotide
 10 sequence thereof.

Table 2 : identification of exon sequences

exon	from nucleotide n°	to nucleotide n°	Sequence which includes said exon
exon 1	1	634	SEQ ID n° 2
exon 2	778	935	
exon 3	403	498	SEQ ID n° 3
exon 4	483	544	SEQ ID n° 4
exon 5	451	522	SEQ ID n° 5
exon 6	416	517	SEQ ID n° 6
exon 7	464	574	SEQ ID n° 7
exon 8	244	348	SEQ ID n° 8
exon 9	134	263	SEQ ID n° 9
exon 10	383	483	SEQ ID n° 10
exon 11	107	198	SEQ ID n° 11
exon 12	211	289	SEQ ID n° 12
exon 13	212	245	SEQ ID n° 13
exon 14	172	234	SEQ ID n° 14
exon 15	207	281	SEQ ID n° 15
exon 16	270	354	SEQ ID n° 16
exon 17	355	413	SEQ ID n° 17
exon 18	80	185	SEQ ID n° 18
exon 19	79	238	SEQ ID n° 19
exon 20	230	377	SEQ ID n° 20
exon 21	185	508	SEQ ID n° 21
exon 22	320	485	SEQ ID n° 22
exon 23	211	261	SEQ ID n° 23
exon 24	115	156	SEQ ID n° 24

5 "A homologous nucleotide sequence" is understood as meaning a sequence which differs from the sequences to which it refers by mutation, insertion, deletion or substitution of one or more bases.

Preferably, such homologous sequences show at least 70 % of homology, preferably 80 % of homology, more preferably 90 % of homology with any of sequences SEQ ID n° 1 to SEQ ID n° 26.

10

A polynucleotide of the invention, having a homologous sequence, hybridizes to the sequences to which it refers (any of sequences SEQ ID n° 1 to SEQ ID n° 26), preferably under stringent conditions. Parameters that define the conditions of stringency depend upon the temperature at which 50 % of annealed strands separate (T_m).

For sequences comprising more than 30 nucleotides, T_m is calculated as follows :

$T_m = 81.5 + 0.41 (\% G + C) + 16.6 \text{ Log (positive ion concentration)} - 0.63 (\% \text{ formamide}) - (600/\text{polynucleotide size in base pairs})$ (Sambrook et al, 1989).

For sequences comprising less than 30 nucleotides, T_m is calculated as follows :

$$T_m = 4(G + C) + 2(A + T).$$

Under appropriate stringent conditions avoiding the hybridization of non specific sequences, hybridization temperature is around from 5°C to 30°C, preferably from 5°C to 10° C below the calculated T_m , and hybridization buffer solutions that are used are preferably solutions with high ionic strength, such as an aqueous 6 X SSC solution for example.

A nucleotide sequence homologous to the open-reading from SEQ ID n° 26 means a nucleotide sequence which differs from the sequences to which it refers by mutation, insertion, deletion or substitution of one or more bases, or by the degeneracy of the genetic code so long as it codes for a polypeptide having the biological activity of oligophrenin 1 protein, as defined below.

Said homologous sequences include mammalian genes coding for the oligophrenin 1 protein, preferably of primate, cattle, sheep, swine, or rodent, as well as allelic variants.

The nucleic acid sequences of the invention are useful for the detection of an abnormality, such as a mutation, in the oligophrenin 1 gene or in the transcripts of the oligophrenin 1 gene. Such an analysis allows *in vitro* diagnosis of a neurological disorder associated with said abnormality.

A subject of the present invention is a method of *in vitro* diagnosis of a neurological disorder associated with an abnormality in the oligophrenin 1 gene or in the transcripts of the oligophrenin 1 gene, wherein one or more mutation(s), preferably inducing a modification of the expression of the oligophrenin 1 gene is detected in the oligophrenin 1 gene or in the transcripts of the oligophrenin 1 gene.

A subject of the present invention is also a nucleic acid comprising a sequence identical to SEQ ID n° 26 or to homologous sequences thereof, except for a one base deletion of the nucleotide 1578 as shown in SEQ ID n° 26.

The present invention relates to methods of *in vitro* diagnosis wherein the nucleic acid sequences of the invention or probes or primers derived thereof are used to detect aberrant synthesis or genetic abnormalities at the oligophrenin 1 gene level.

The present invention is more particularly directed to a method of *in vitro* diagnosis comprising the steps of :

- contacting a biological sample containing DNA with specific oligonucleotides permitting the amplification of all or part of the oligophrenin 1 gene, the DNA contained in the sample having being rendered accessible, where appropriate, to hybridization, and under conditions permitting a hybridization of the primers with the DNA contained in the biological sample ;
- amplifying said DNA ;
- detecting the amplification products ;
- comparing the amplified products as obtained to the amplified products obtained with a normal control biological sample, and thereby detecting a possible abnormality in the oligophrenin 1 gene.

The method of the invention can also be applied to the detection of an abnormality in the transcript of the oligophrenin 1 gene, by amplifying the mRNAs contained in a biological sample, for example by RT-PCR.

Thus another subject of the present invention is a method of in vitro diagnosis, as previously defined comprising the steps of :

- producing cDNA from mRNA contained in a biological sample ;
- contacting said cDNA with specific oligonucleotides permitting the amplification of all or part of the transcript of the oligophrenin 1 gene, under conditions permitting a hybridization of the primers with said cDNA ;
- amplifying said cDNA ;
- detecting the amplification products ;
- comparing the amplified products as obtained to the amplified products obtained with a normal control biological sample, and thereby detecting a possible abnormality in the transcript of the oligophrenin 1 gene.

This comparison of the amplified products obtained from the biological sample with the amplified products obtained with a normal biological sample can be carried out for example by specific probe hybridization, by sequencing or by restriction site analysis.

A subject of the present invention is also a nucleic acid sequence which specifically hybridizes with a nucleic acid sequence of the invention as previously defined or with their complementary sequences.

"A sequence which specifically hybridizes [...]" is understood as meaning a sequence which hybridizes with the sequences to which it refers under the conditions of high stringency (Sambrook et al, 1989). Such sequences are preferably oligonucleotides having at least 15, and more preferably at least 20 bases.

Such sequences, which are useful as primers or probes for the diagnosis methods according to the present invention may be preferably

selected from the group consisting of nucleic acid fragments of SEQ ID N° 2 to SEQ ID N° 26 as shown in table 3, or the complementary sequences thereof.

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Table 3 : identification of the oligonucleotide sequences

Oligonucleotides		Sequence which includes said oligonucleotide
from nucleotide n°	to nucleotide n°	
727	746	SEQ ID n° 2
958	977	
375	394	SEQ ID n° 3
504	523	
418	437	SEQ ID n° 4
551	570	
423	445	SEQ ID n° 5
553	574	
388	407	SEQ ID n° 6
540	559	
436	458	SEQ ID n° 7
584	603	
219	239	SEQ ID n° 8
363	381	
108	128	SEQ ID n° 9
336	355	
361	380	SEQ ID n° 10
492	511	
81	100	SEQ ID n° 11
223	242	
188	207	SEQ ID n° 12
300	319	
166	189	SEQ ID n° 13
259	278	
133	152	SEQ ID n° 14
250	269	
151	170	SEQ ID n° 15
293	315	
221	244	SEQ ID n° 16
363	382	
305	324	SEQ ID n° 17
438	457	
25	44	SEQ ID n° 18
218	237	
51	70	SEQ ID n° 19
252	271	
206	225	SEQ ID n° 20
383	402	
151	170	SEQ ID n° 21
511	530	
294	313	SEQ ID n° 22
496	515	
179	198	SEQ ID n° 23
271	291	
65	84	SEQ ID n° 24
165	184	
152	172	SEQ ID n° 26
586	606	
641	663	

00727 224 2550

One skilled in the art very well knows the standard methods for analysing the DNA contained in a biological sample and for diagnosing a genetic disorder. Many strategies for genotypic analysis are available (Antonarakis et al., 1989, Cooper et al., 1991).

5 Preferably, one can use the DGGE method (Denaturing Gradient Gel Electrophoresis), or the SSCP method (Single Strand Conformation Polymorphism) for detecting an abnormality in the oligophrenin 1 gene. Such methods are preferably followed by direct sequencing. The RT-PCR method may be advantageously used for detecting abnormalities in the oligophrenin 1
10 transcript, as it allows to visualize the consequences of a splicing mutation such as exon skipping or aberrant splicing due to the activation of a cryptic site. This method is preferably followed by direct sequencing as well. The more recently developed technique using DNA chip can also be advantageously implemented for detecting an abnormality in the oligophrenin 1 gene (Bellis et
15 al., 1997).

The cloning of the oligophrenin 1 gene, as well as the identification of various mutations responsible for neurological disorders according to the invention, allow direct or semi-direct diagnosis. The specificity and reliability of such diagnosis methods are more particularly appreciable for
20 prenatal diagnosis. The nucleic acid sequences of the present invention represent a highly interesting tool for genetic counseling.

The authors of the present invention have shown that the oligophrenin 1 protein is a rho-GAP protein and that the constitutional loss of
25 oligophrenin 1 activity in humans results in cognitive impairment. Defects in the oligophrenin 1 gene, or in the oligophrenin 1 gene product may cause inactivation of the oligophrenin 1 protein, which leads to constitutive activation of its target GTPases.

Such constitutive activation of rho family members has been
30 shown to produce marked changes in certain actin-based processes, to alter the cytoskeleton in cultured cells (Nobes et al., 1995) and to affect cell migration and axon outgrowth in vivo (Luo et al., 1994). In addition,

constitutively active Rac1 rho-GTPase produced neuropathological changes in transgenic mice such as defects in axon outgrowth and dendritic spine morphogenesis in mouse Purkinje cells (Luo et al., 1996).

In the same manner, constitutive activation of a rho-GTPase
5 resulting from the loss-of-function of oligophrenin 1 protein leads to a dysfunctioning of signal transduction pathways involved in cell migration and axon outgrowth during development of the nervous system. Mental retardation may be the clinical expression of such neuropathological changes.

The oligophrenin 1 gene would thus be involved in disorders due
10 to an abnormal neurone migration. Such disorders include not only genetic disorders such as nonspecific X-linked mental retardation but also incurable cryptogenic epilepsies and neurodegenerative diseases, such as Alzheimer's disease and cognitive impairments related to aging.

15 The present invention also provides transgenic non-human animals or cells thereof.

Said transgenic animal can have a exogenous oligophrenin 1
protein of this invention due to the presence of a gene encoding and
expressing that protein or part of that protein.

20

Transgenic animals are generally well known, as are their methods of production.

The present invention contemplates a non-human animal
containing a oligophrenin 1 gene of the present invention integrated in the
25 genome of the animal's somatic and germ cells, i.e., a transgenic animal, preferably transgenic mammals.

Animals containing a transgene encoding a oligophrenin 1
protein of the present invention are typically prepared using the standard
transgenic technology described in Hogan et al. (1987) and Palmiter et al.
30 (1986). Production of transgenic mammals is also possible using the homologous recombination transgenic systems described by Capecchi (1989). Preparation of transgenic mammals has also been described in WO94/21670.

One technique for transgenically altering a mammal is to microinject a rDNA into the male pronucleus of the fertilized mammalian egg to cause one or more copies of the rDNA to be retained in the cells of the developing mammal.

5 Alternative methods for producing a non-human mammal containing a rDNA of the present invention include infection of fertilized eggs, embryo-derived stem cells, totipotent embryonal carcinoma (Ec) cells, or early cleavage embryos with viral expression vectors containing the rDNA (Palmiter et al., (1986)).

10 A transgenic animal can also have a mutation in its own native oligophrenin 1 gene, thereby rendering the oligophrenin 1 protein non-functional (i.e., a "knockout" transgenic animal). Such an animal is useful as it presents the clinical conditions associated with the defects in the mutated
15 oligophrenin 1 protein, and further can be a model for evaluation of candidate therapeutics that would treat subjects with defects in that protein.

20 More particularly, transgenic non-human animals or cells in culture, that overexpress oligophrenin 1 protein or preferably express a native oligophrenin 1 protein that has been rendered non-functional ("knock-out" transgenic animal) may be useful in a method for screening chemical entities or drugs likely to act on the signaling pathway to which the rho-GAP^{MRX} protein (oligophrenin) belongs.

25 Transgenic non-human animals or cells thereof that overexpress oligophrenin 1 protein refer to animals or cells thereof that express an exogenous oligophrenin 1 protein of the invention in addition not the native protein.

In one embodiment, the screening method of the invention comprises the steps of :

30 i) administering a drug to be tested to a transgenic non-human animal that overexpress oligophrenin 1 protein or preferably express a native oligophrenin 1 protein that has been rendered non-functional ; and

ii) observing clinical expression of neuronal changes *in vivo* and/or *in vitro* culturing nervous cells from said animal and observing the stimulation or recovery of axon outgrowth or morphogenesis.

In another embodiment, the screening method of the invention
5 comprises the steps of :

i) contacting a drug to be tested with nervous cells or nervous tissue cultures that overexpress oligophrenin 1 protein or preferably express a native oligophrenin 1 protein that has been rendered non-functional ; and

ii) measuring the axon outgrowth.

10 In the above embodiment, said cells are either obtained from said transgenic animals or are established cell lines, such as neuroblastoma or primary cultures of neuronal cells, which have been transfected by a DNA construct, e.g by means of a viral vector, allowing the expression of exogenous oligophrenin 1 protein or rendering the native oligophrenin 1 non functional.

15 Drugs selected by the methods of screening as above-defined, and pharmaceutical compositions containing such a drug in association with a pharmaceutically acceptable carrier, are also encompassed by the present invention.

20 The ORF of the oligophrenin 1 gene as shown in SEQ ID n° 26 according to the invention encodes a protein of 802 amino acids with a relative molecular mass of 91 kD. Hydropathy analysis (Kyte and Doolittle, 1982) suggests that the oligophrenin 1 protein is hydrophilic. Based on consensus motifs in PROSITE database (Bairoch et al., 1997), many potential
25 phosphorylation sites were predicted including a tyrosine kinase phosphorylation site at position 142. Comparison of the protein sequence with other sequences in the databases indicated that the oligophrenin 1 gene encodes a rho-GAP containing protein.

30 Sequence alignment shown in figure 3b illustrates the remarkable similarity between the predicted oligophrenin 1 domain and other members of the rho-GAP subfamily. This similarity extends over 180 residue region localised in the central part of the predicted protein and concerns the three

structurally conserved regions (SCRs) that are specific to the rho-GAP proteins.

Among rho-GAPs, the oligophrenin 1 protein showed the greatest similarity to the chicken Graf protein (Hildebrand et al., 1996). This similarity extends on both sides of the rho-GAP domains, but oligophrenin 1 does not contain the SH3 domain reported for the Graf protein. The rho-GAP activity of the oligophrenin 1 protein is consistent with the functional analysis of the chicken Graf protein, which has both part of the N-terminal and rho-GAP domains identified in the oligophrenin 1 protein. Graf protein has been shown to preferentially stimulate the GTPase activity of the GTP-binding proteins RhoA and Cdc42 (Hildebrand et al., 1996).

The C-terminal part of oligophrenin 1 protein does not match any known sequence, whereas the N-terminal domain of oligophrenin 1 protein is similar to a highly conserved protein, of unknown function, identified in *C. elegans*, mouse and human (Fig. 3c). This protein presents two isoforms identified as CELZK328 and CELT04C95 (Genbank), which correspond to two different ORF.

A further subject of the present invention is thus an isolated oligophrenin 1 polypeptide substantially comprising the aminoacid sequence of SEQ ID n° 27 or a homologous aminoacid sequence thereof.

The above term "substantially" is understood as meaning that said isolated oligophrenin 1 polypeptide exhibits the same biological and/or immunological properties, as the native oligophrenin 1 protein.

More particularly said aminoacid sequence may be SEQ ID n° 26, or a homologous aminoacid sequence thereof.

"A homologous aminoacid sequence" is understood as meaning a sequence which differs from the sequences to which it refers by mutation, insertion, deletion or substitution of one or more aminoacids, without inducing modification of biological and/or immunological properties. Said derivative

aminoacid sequence shows at least 60 % of homology, preferably 70 % of homology, preferably 80 % of homology with the oligophrenin 1 polypeptide of SEQ ID n° 26.

5 The "biological properties" of the polypeptides of the invention refer to the activity of the oligophrenin 1 protein, which enhances GTPase activity of small Ras-like GTPases and hence turns them off.

10 The "immunological properties" of the polypeptides of the invention refer to the ability of the polypeptides of the invention to induce an immunological response mediated by antibodies which recognize the oligophrenin 1 polypeptide of the invention.

15 The polypeptides according to the invention can be obtained by any of the standard methods of purification of soluble proteins, by peptide synthesis or by genetic engineering. Said techniques comprise the insertion of a nucleic acid sequence coding for a peptide of the invention into an expression vector, such as a plasmid, and the transformation of host cells with the expression vector, by any of the methods available to the skilled person, like for instance electroporation.

20 The present invention thus relates to vectors for cloning and/or expression comprising a nucleic acid sequence of the invention and to host cell transfected with these vectors. The expression vector according to the invention comprises a nucleic acid sequence encoding a polypeptide of the invention, said nucleic acid sequence being operably linked to elements
25 allowing its expression. Said vector advantageously contains a promoter sequence, signals for initiation and termination of translation, as well as appropriate regions for regulation of translation. Its insertion into the host cell may be transient or stable. Said vector may also contain specific signals for secretion of the translated protein.

30 These various control signals are selected according to the host cell which may be inserted into vectors which self-replicate in the selected host cell, or into vectors which integrate the genome of said host.

Host cells may be prokaryotic or eukaryotic, including but not limiting to bacteria, yeasts, insect cells, mammalian cells, including cell lines which are commercially available.

A subject of the present invention is also a method for producing
5 a recombinant oligophrenin 1 polypeptide, wherein said host cell is transfected with said expression vector and is cultured in conditions allowing the expression of a polypeptide according to the invention.

The present invention also relates to monoclonal or polyclonal
10 antibodies, or fragments thereof, or chimeric or immunoconjugate antibodies, which are capable of specifically recognizing a polypeptide according to the invention.

Polyclonal antibodies can be obtained from serum of an animal immunized against the oligophrenin 1, which can be produced by genetic
15 engineering for example, as above described, according to standard methods well-known by one skilled in the art.

Monoclonal antibodies can be obtained according to the standard method of hybridoma culture (Kohler and Milstein, 1975).

The antibodies of the present invention can be chimeric
20 antibodies, humanized antibodies, or antigen binding fragments Fab and F(ab')₂. They can also be immunoconjugated or labelled antibodies.

Said antibodies are particularly useful for detecting or purifying a oligophrenin 1 polypeptide according to the invention in a biological sample.

They are more particularly useful for detecting an abnormal
25 expression of the oligophrenin 1 protein in connection with neurological disorders as above described.

Another subject of the present invention is a pharmaceutical composition comprising a purified oligophrenin 1 polypeptide of the invention
30 and/or a homologous polypeptide thereof, in association with a pharmaceutically acceptable carrier.

A further subject of the present invention is a pharmaceutical composition comprising a nucleic acid encoding said polypeptides and a pharmaceutically acceptable carrier. Said nucleic acid, preferably inserted in a vector, may be administered in a naked form or in association with transfection facilitating agents.

A further subject of the invention is a pharmaceutical composition comprising an anti-sense sequence capable of specifically hybridizing with a nucleic acid sequence encoding said polypeptides, in association with a pharmaceutically acceptable carrier.

A still further subject of the invention is a pharmaceutical composition comprising an antibody directed against said polypeptides, in association with a pharmaceutically acceptable carrier.

Preferably the present invention is directed to a pharmaceutical composition comprising a purified oligophrenin 1 polypeptide of the invention and/or a homologous polypeptide thereof, in association with a pharmaceutically acceptable carrier.

The term "homologous polypeptide", as active ingredient of a pharmaceutical composition, refers to a polypeptide with a homology of at least 40 %, preferably of at least 60 % in comparison to the oligophrenin 1 protein. Such homologous polypeptides include any known protein which exhibits a rho-GAP activity. Preferably said homologous polypeptide is for example the protein CELZK328 or CELT04C95.

The pharmaceutical compositions of the invention are useful for preventing and/or treating neurological disorders, wherein the oligophrenin 1 protein or a homologous protein thereof is implicated. As above underlined, the authors of the present invention have shown that defects in a Ras-like GTPase (rho-GAP) dependent signalling pathway are associated with cognitive impairment, resulting from misguided axon growth and/or defective cell migration. Consequently, the disorders which are more particularly aimed at are disorders of the central nervous system in connection with the axonal

development, more particularly a disorder associated with cognitive impairment. Such disorders include nonspecific X-linked mental retardation, as well as cryptogenic epilepsies or neurodegenerative diseases, such as Alzheimer's disease and cognitive impairments related to aging.

5

Another subject of the invention is the use of a purified oligophrenin 1 polypeptide of the invention and/or a homologous polypeptide thereof, in association with a pharmaceutically acceptable carrier for the manufacture of a medicine for preventing and/or treating neurological disorders, wherein the oligophrenin 1 protein or a homologous protein thereof is implicated.

10

The pharmaceutical compositions of the invention may be administered to a mammal, preferably to a human, in need of a such treatment, according to a dosage which may vary widely as a function of the age, weight and state of health of the patient, the nature and severity of the complaint and the route of administration.

15

The appropriate unit forms of administration comprise oral forms such as tablets, gelatin capsules, powders, granules and oral suspensions or solutions, sublingual and buccal administration forms, subcutaneous, intramuscular, intravenous, intranasal or intraocular administration forms and rectal administration forms.

20

A further subject of the present invention is a method of preventing and/or treating neurological disorders resulting from defects in the oligophrenin 1 gene or in the oligophrenin 1 protein or in a homologous gene or protein thereof, which comprises administering to a subject in need of a such treatment an amount of a pharmaceutical composition as above defined effective to prevent and/or alleviate said neurological disorders.

25

30

The present invention is further illustrated by, but not limited to, the figures and the examples that follow.

LEGENDS TO FIGURES :

5 **Figure 1.** (a) Physical map of the Xq12 locus and genomic structure of the oligophrenin 1 gene spanning the X-chromosomal breakpoint. YAC, PAC and cosmid contigs are indicated with lines and STSs by vertical bars. The STS C16T3 was generated from the distal end of the 9 kb HindIII fragment containing the X-chromosomal breakpoint (represented by an arrow). The
10 oligophrenin 1 gene spans at least 300 kb and it consists of 25 exons of which 23 are coding (white boxes). (b) Southern blot analysis of HindIII digested genomic DNAs from the patient exhibiting the (X;12) translocation and a normal female using the STS C16 T3 as probe. The junction fragment is indicated by JF.

15 **Figure 2.** Fetal and multiple adult tissue northern blots containing poly(A)⁺ RNA (Clontech®) hybridized with C2 cDNA probe. A 7.5 kb transcript was observed after an overnight exposure at - 80°C. Hybridization of Northern blots with an actin probe was performed to assess differences between
20 amounts of loaded poly(A)⁺ RNA samples.

Figure 3. (a) Coding part of the cDNA and deduced amino acid sequences of the oligophrenin 1 gene. Nucleotides in bold correspond to exon-exon boundaries. The GAP domain is underlined, Primers used in RT-PCR to study
25 the expression of the gene in the patient with the X;12 translocation are double underlined and the internal primer used for hybridization to ascertain PCR products is shown in dotted line. The deleted nucleotide at position 1578 is indicated in italic bold case. (b) Sequence alignment of the GAP domain present in oligophrenin 1 and different rhoGAP proteins reviewed in Aelst et al., 1997. The GAP domain contains three Structurally Conserved Regions (SCRs) (Boguski et al., 1993). CELZK328 corresponds to an ORF predicted
30 from sequences of the *C.elegans* genome. (c). Sequence alignment showing

the high conservation of oligophrenin 1 N-terminal domain. CELTO4C95 corresponds to another *C. elegans* ORF, different from CELZK328. EST483210 is part of the mouse homologue oligophrenin 1 cDNA and EST387042 corresponds to a human EST that was localized on chromosome 11 by the Whitehead Institute.

Identical residues are indicated by black shading, similar residues by grey. The alignment was performed using Multalin (Corpet et al., 1988) and Boxshade softwares.

Figure 4. (a). Study of oligophrenin 1 transcript in the patient with the (X;12) translocation and in a normal female used as control (XX). Southern blot of PCR products amplified from total RNAs isolated from EBV transformed lymphoblastoid cell lines.

(b) Nucleotide sequences showing the one base pair deletion. Direct sequencing of PCR products corresponding to exon 19 of IV-3 proband.

(c). Segregation analysis of the mutated allele in XLMR family D. Open squares, unaffected males; closed squares, affected males; open circles, unaffected females; dotted symbols, phenotypically normal carrier females.

EXAMPLE 1 : Identification of the oligophrenin 1 gene :**1. Experimental procedures****Case report and family materials**

Clinical data and diagnosis concerning the female patient with the t(X;12) translocation were previously described (Luo et al., 1996). Concerning the MRX families, a linkage study was reported in The European XLMR Consortium 's report (1997).

YAC and PAC clones

YAC clones of the Xq12 locus were obtained from the UK HGMP Resource Centre. PAC clones were obtained from the German resource center (RZPD). Primer sequences corresponding to STSs are available in Genome Data Base. STSC16T3 is a 189 bp fragment amplified with the primers: C16T3F (5' CACAGCAAGCAATAAGCACT 3') and C16T3R (5' TGTCTCCTGTGCTCTTTCCA 3'). Overlaps between clones and STS mapping were performed by a combination of STS/EST amplification and hybridization approaches.

cDNA isolation

Approximately 1×10^6 recombinant clones of a lgt10 human fetal brain cDNA library (Clontech) were plated and screened following standard techniques (Sambrook et al., 1989). Library screening was performed using as probe RT-PCR products generated with primers located within the predicted exons. Positive clones were plaque purified and their inserts were subcloned into bluescript vector and sequenced. 3' RACE PCR (Clontech kit) was used to obtain the 3' end of the cDNA. The full-length cDNA is a composite of 14 clones (only 4 clones are represented on figure 1a).

Genomic DNA sequencing of human cosmid clones:

Human cosmid clones were detected in the Imperial Cancer
5 Research Fund (ICRF) flow-sorted human X chromosome library (Nizetic et al.,
1991) using B2 cDNA as a probe. Cosmid 2C6, 4D2 and 35 shown in figure 1a
are from a cosmid library corresponding to the YAC 4690. Exon-intron
boundaries were identified through sequence comparisons between cDNA and
genomic DNA clones. To generate genomic sequences, DNAs of cosmid
10 clones were used as templates and primed with exonic oligonucleotides. ICRF
coordinates of cosmid clones shown in figure 1 are as follow: cos12:
ICRFc104J1515Q8, cos15: ICRFc104K1628Q8, cos7: ICRFc104P0212Q8,
cos3: ICRFc104B1719Q8, cos11: ICRFc104F178Q8, cos5:
ICRFc104B1515Q8.

2. Results :

As a first step in identifying a potential gene in Xq12 involved in
MRX, Bienvenu *et al.* (1997) have reported a molecular cytogenetic
20 investigation of an X;12 balanced translocation observed in a female affected
with a mild mental retardation. The Xq breakpoint was localized within an ICRF
850 kb YAC clone y900H0493 (4690), positive for PGKP1 and DXS159
markers.

The authors of the present invention have used long-range
25 restriction maps of the YAC clone 4690, FISH analyses and somatic hybrid cell
lines containing the derivative chromosome 12 as their only human X-
chromosomal component to regionally fine map the X chromosomal
breakpoint. Figure 1a depicts the location of the translocation breakpoint on
the normal X and summarizes YAC, PAC and cosmid contigs spanning the
30 breakpoint. The probe, STSC16T3, which detects the junction fragment and
localized the breakpoint to a 9 kb HindIII fragment (fig 1b) was isolated from
the cosmid clone 4D2 (Fig 1a). Aberrant bands confirming the latter results

were also obtained by hybridization of the same probe to a Southern blot containing DNA from the patient digested with several other enzymes.

Sequencing of randomly subcloned HindIII fragments including the 9 kb fragment isolated from cosmid clones spanning the breakpoint, and searches for homology in data bases revealed sequence identities between the isolated sequences and those corresponding to the PAC clone 360E18 (Fig 1a) which were generated by the Sanger Centre (Cambridge,UK). Available sequences were then used for computational analyses and comparison with nucleotide and protein sequences. Some of the potential exons identified by GRAIL (Kel et al., 1993) and FEXH/HEXON (Lerman et al., 1987) programs showed a significant homology with the mouse EST 483210. The predicted polypeptide corresponding to this EST revealed a significant homology with the human EST 387042 localised on chromosome 11 and with the *C. elegans* ORF CELT04C95. Further investigations suggested that the *C. elegans* ORF is represented on the genomic sequences derived from the PAC clone by 8 different potential exons scattered over 130 kb (Fig. 1a). These predictions were confirmed by RT-PCR experiments using primers located within the potential exons and human fetal brain total RNA. Furthermore, hybridization of the RT-PCR products to a Northern blot containing polyA⁺ RNA detected a 7.5 kb transcript most highly expressed in fetal brain (Fig. 2). Together, these results indicated the presence of a candidate gene located in the vicinity of the translocation breakpoint.

In order to identify the full length cDNA the authors of the present invention used a combination of fetal brain cDNA library screening, PCR and rapid amplifications of cDNA ends (RACE). This approach enabled to obtain a composite full length nucleotide sequence of the cDNA (Figure 3a).

To confirm that the identified gene is disrupted by the translocation breakpoint the structure of the gene including the exon-intron boundaries was determined through sequence comparisons between cDNA and cosmid genomic DNA clones isolated either from a cosmid library generated from YAC clone 4690 or the ICRF flow sorted X-specific cosmid

library (fig 1a). The physical mapping of the 25 exons allowed to demonstrate that the candidate MRX gene is transcribed from telomere to centromere and the translocation breakpoint maps within the second intron leading therefore to a displacement on the derivative chromosome 12 of the first two exons including the one containing the putative translation initiation codon. Confirmation of this latter result was obtained by FISH analysis using as probe a cosmid clone containing the first two exons of the gene (cos 12, fig 1a). This experiment showed that this cosmid maps exclusively on the derivative chromosome 12 (data not shown).

To investigate the gene expression and examine whether both alleles are inactive, RT-PCR experiments were performed on RNA isolated from EBV-transformed lymphoblastoid cell lines (LCL) of the patient and a female control using primers located in exons 1 and 2. These experiments failed to amplify a normal gene product on RNA of the patient (fig 4a). Consistently, the normal X chromosome was found to be late replicating, indicating preferential X-inactivation of the normal X chromosome (Bienvenu et al., 1997), and the MRX candidate gene was found to undergo X-inactivation.

EXAMPLE 2 : Identification of mutations in MRX families

1. Experimental procedure

Mutations analysis

Genomic DNA was extracted from EBV - transformed lymphoblastoid cell lines using standard protocols. The 23 coding exons and exon-intron boundaries were individually amplified with specific primers. In each amplification one primer was a 5' psoralen-modified primer (Fernandez et al., 1993). PCR products were checked on standard agarose gels prior to analysis by the DGGE technique. When an aberrant pattern of migration was observed, the corresponding PCR product was purified and directly sequenced

on both strands using the Dye Terminator Cycle Sequencing kit protocol (Applied Biosystems).

Figure 4(a) represents a Southern blot of PCR products amplified from total RNAs isolated from EBV transformed lymphoblastoid cell lines. RT-PCR were performed with (+) or without (-) reverse transcriptase and cDNAs were amplified for 40 cycles with primers located in exon 1 and 2 (figure 3, double underlined nucleotide sequences). After gel electrophoresis, the Southern blot was hybridized with an internal oligonucleotide (dotted line on figure 3). The 650 bp fragment corresponds to an amplification from the contaminating genomic DNA (intron 1 is 140 bp long). The lane labelled DNA, corresponds to the PCR product obtained from a female total genomic DNA. The negative control indicated by Ct(-) corresponds to a PCR experiment without template. RT-PCR amplification of the ubiquitously expressed transcript produced by the distal part of the dystrophin gene was used as internal standard.

The mutation to co-segregate with the mental retardation phenotype as shown on figure 4c was detected by denaturing gradient gel electrophoresis of PCR products corresponding to exon 19 of the oligophrenin 1 gene. Exon 19 was amplified by PCR with primers 19F (5' GTT AAT CTT GCC CCT TTT CT 3') and 19R (5' Psoralen- TA GGA AGA CAG GTA GTG AGA AT) yielding a 221 bp product. 10 µl of each amplified product was mixed with 10 µl of normal control PCR product. Heteroduplexes were generated by denaturing for 10 min, and subsequent reannealing for 45 min at 56°C. The samples were electrophoresed through a 25-65% denaturant 6% polyacrylamide gel for 7.5h at 60°C and 160V. The characteristic shifted profile displayed by the mutated allele allow an easy study of the familial segregation.

2. Results

In order to prove that the isolated gene is responsible for non-specific mental retardation, four unrelated probands from MRX families (The

European XLMR Consortium, 1997), previously mapped in genetic intervals which encompass the candidate gene, were analysed for the presence of point mutations. The strategy involved investigation by DGGE (Lerman et al., 1993) (denaturing gradient gel electrophoresis) of PCR products corresponding to all coding exons and sequencing of exons exhibiting abnormal migration profiles. PCR primers were designed not only to amplify individual exons but also sequences flanking the exons. DGGE analyses of amplified products, corresponding to exon 19, from the proband IV-3 of the family D (fig 4c) showed an abnormal shift in mobility. Compared with the normal product, sequence analysis showed that the aberrant product contained a one base pair deletion of the nucleotide 1578 (fig 4b); the resulting frameshift mutation was predicted to cause premature translation termination four codons downstream of the mutation. Cosegregation of the mutation with the disease which was confirmed in the large family using the DGGE technique (fig 2b) and the absence of this mutation in 100 control individuals indicate that the deletion does indeed cause the mutant phenotype.

EXAMPLE 3 : Expression of the oligophrenin 1 gene

C2 cDNA clone was isolated from a fetal brain cDNA library. C2 DNA probe was used to hybridize poly(A)⁺ RNA (Clontech©) contained in fetal and multiple adult tissues. A 7.5 kb transcript was observed after an overnight exposure at - 80°C. Hybridization of Northern blots with an actin probe was performed to assess differences between amounts of loaded poly(A)⁺ RNA samples.

As shown in figure 2, the oligophrenin 1 transcript was most abundant in RNA from fetal brain. A lower level of expression was also detected in several other tissues including adult brain. To further investigate the distribution of the transcript during development, *in situ* hybridization was used to examine the expression of the mouse homologous gene in embryonic days (E) 10.5, E12.5, E14, E18 and in postnatal day 1 of mouse embryos and

postnatal tissues. In addition to a low expression in all tissues with no significant differences, it was found that the gene is expressed at a higher level in all parts of the developing neuroepithelium of the neural tube. During later differentiation stages and in the mature brain a significant level of expression is visible in different structures of the brain with no striking distribution of the mRNA expression.

Several lines of evidence show that defects in oligophrenin 1 are responsible for X-linked non-specific mental retardation. First, the oligophrenin 1 gene maps to a potential mental retardation genetic locus in Xq12 identified by linkage analyses (Lubs et al., 1996, The European XLMR Consortium, 1997). Second, literature reports (Davies, 1997) concerning two patients with complete androgen insensitivity syndrome (CAIS) and mental retardation showed the presence of deletions which include several markers both proximal and distal to the AR gene and extend to DXS905 and DXS908. The above mapping data showed that these markers are located within the second and fifth intron of the oligophrenin 1 gene (Fig. 1a), demonstrating therefore that most of the exons are deleted in these two patients with mental retardation. In contrast, deletions in two CAIS patients without mental retardation do not extend to the oligophrenin 1 gene as deletions are limited to the androgen receptor gene itself (Davies, 1997). Third, investigation of this gene in the female patient with mental retardation and a t(X;12) demonstrated an absence of expression of both alleles resulting from the disruption of one allele by the translocation breakpoint and a preferential inactivation of the second allele. Fourth, a one base pair deletion within the rho-GAP domain, predicted to result in a severe abbreviated and nonfunctional oligophrenin 1 protein, cosegregates with a recessive mental retardation phenotype in a large affected family mapped to the pericentromeric region. Finally, the oligophrenin 1 mRNA is highly expressed in fetal brain, a finding consistent with the disease phenotype.

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MODIFIED CLAIMS

5 1. Nucleic acid, the **sequence of which** is selected from the group consisting of sequences SEQ ID n° 1 to SEQ ID n° 25, and a homologous nucleic acid sequence thereof.

10 2. Nucleic acid, the **sequence of which** is selected from the group consisting of exon sequences as identified in table 2, and a homologous nucleic acid sequence thereof.

15 3. Nucleic acid comprising the sequence as shown in SEQ ID n° 26, a homologous sequence thereof, or a sequence identical to SEQ ID n° 26, except for a one base deletion of the nucleotide 1578 as shown in SEQ ID N° 26.

20 4. Isolated oligophrenin 1 polypeptide substantially comprising the aminoacid sequence of SEQ ID n° 27, or a homologous amino acid sequence thereof.

25 5. Vector for cloning and/or expression comprising a nucleic acid sequence of any of claims 1 to 3.

30 6. Host cell transfected with a vector according to claim 5.

7. Nucleic acid, the **sequence of which** has at least 15 bases and specifically hybridizes with a nucleic acid sequence according to any of claims 1 to 2, under stringent conditions.

8. Nucleic acid, the **sequence of which** has at least 15 bases and specifically hybridizes with a nucleic acid sequence according to claim 3 under stringent conditions.

9. Nucleic acid of claim 7 or 8, the **sequence of which** is selected from the group consisting of the sequences identified in table 3 or the complementary sequences thereof, said sequences identified in table 3 consisting of:

30 - nucleotide n° 727 to 746 of SEQ ID n° 2

- nucleotide n° 958 to 977 of SEQ ID n° 2
- nucleotide n° 375 to 394 of SEQ ID n° 3
- nucleotide n° 504 to 523 of SEQ ID n° 3
- nucleotide n° 418 to 437 of SEQ ID n° 4
- nucleotide n° 551 to 570 of SEQ ID n° 4
- nucleotide n° 423 to 445 of SEQ ID n° 5
- nucleotide n° 553 to 574 of SEQ ID n° 5
- nucleotide n° 388 to 407 of SEQ ID n° 5
- nucleotide n° 540 to 559 of SEQ ID n° 6
- nucleotide n° 436 to 458 of SEQ ID n° 7
- nucleotide n° 584 to 603 of SEQ ID n° 7
- nucleotide n° 219 to 239 of SEQ ID n° 8
- nucleotide n° 363 to 381 of SEQ ID n° 8
- nucleotide n° 108 to 128 of SEQ ID n° 9
- nucleotide n° 336 to 355 of SEQ ID n° 9
- nucleotide n° 361 to 380 of SEQ ID n° 10
- nucleotide n° 492 to 511 of SEQ ID n° 10
- nucleotide n° 81 to 100 of SEQ ID n° 11
- nucleotide n° 223 to 242 of SEQ ID n° 11
- nucleotide n° 188 to 207 of SEQ ID n° 12
- nucleotide n° 300 to 319 of SEQ ID n° 12
- nucleotide n° 166 to 189 of SEQ ID n° 13
- nucleotide n° 259 to 278 of SEQ ID n° 13
- nucleotide n° 133 to 152 of SEQ ID n° 14
- nucleotide n° 250 to 269 of SEQ ID n° 14
- nucleotide n° 151 to 170 of SEQ ID n° 15
- nucleotide n° 293 to 315 of SEQ ID n° 15
- nucleotide n° 221 to 244 of SEQ ID n° 16
- nucleotide n° 363 to 382 of SEQ ID n° 16
- nucleotide n° 305 to 324 of SEQ ID n° 17
- nucleotide n° 438 to 457 of SEQ ID n° 17
- nucleotide n° 25 to 44 of SEQ ID n° 18
- nucleotide n° 218 to 237 of SEQ ID n° 18
- nucleotide n° 51 to 70 of SEQ ID n° 19

- nucleotide n° 252 to 271 of SEQ ID n° 19
- nucleotide n° 206 to 225 of SEQ ID n° 20
- nucleotide n° 383 to 402 of SEQ ID n° 20
- nucleotide n° 151 to 170 of SEQ ID n° 21
- nucleotide n° 511 to 530 of SEQ ID n° 21
- nucleotide n° 294 to 313 of SEQ ID n° 22
- nucleotide n° 496 to 515 of SEQ ID n° 22
- nucleotide n° 179 to 198 of SEQ ID n° 23
- nucleotide n° 271 to 291 of SEQ ID n° 23
- nucleotide n° 65 to 84 of SEQ ID n° 24
- nucleotide n° 165 to 184 of SEQ ID n° 24
- nucleotide n° 152 to 172 of SEQ ID n° 26
- nucleotide n° 586 to 606 of SEQ ID n° 26
- nucleotide n° 641 to 663 of SEQ ID n° 26

10. Method for producing a recombinant oligophrenin 1 polypeptide, wherein a host cell of claim 6 is cultured in conditions allowing the expression of a polypeptide according to claim 4.

11. Monoclonal or polyclonal antibodies, or fragments thereof, chimeric or immunoconjugate antibodies, which are capable of specifically recognizing a polypeptide according to claim 4.

12. Use of the antibodies of claim 11 for detecting or purifying a polypeptide according to claim 4 in a biological sample.

13. Use of a nucleic acid according to any of claims 1, 2, 3, 7, 8 and 9, for detecting an abnormality in the oligophrenin 1 gene or in the transcripts of the oligophrenin 1 gene.

14. Method of *in vitro* diagnosis of a neurological disorder associated with an abnormality in the oligophrenin 1 gene or in the transcripts of the oligophrenin 1 gene, wherein one or more mutation(s) is detected in any of the sequences of claims 1 to 3.

15. Method according to claim 14 wherein said mutation is a one base deletion of the nucleotide 1578 as shown in SEQ ID N° 26.

16. Method of *in vitro* diagnosis according to any of claims 14 or 15 comprising the steps of :

5 - contacting a biological sample containing DNA with specific oligonucleotides having a sequence as defined in claim 7, permitting the amplification of all or part of the oligophrenin 1 gene, the DNA contained in the sample having being rendered accessible, where appropriate, to hybridization, and under conditions permitting a hybridization of the oligonucleotides with the DNA
10 contained in the biological sample ;

- amplifying said DNA ;

- detecting the amplification products ;

- comparing the amplified products as obtained to the amplified products obtained with a normal control biological sample, and thereby detecting a possible abnormality in the oligophrenin 1 gene.

17. Method of *in vitro* diagnosis according to any of claims 14 or 15 comprising the steps of :

- producing cDNA from mRNA contained in a biological sample ;

20 - contacting said cDNA with specific oligonucleotides having a sequence as defined in claim 8, permitting the amplification of all or part of the transcript of the oligophrenin 1 gene, under conditions permitting a hybridization of the primers with said cDNA ;

- amplifying said cDNA ;

25 - detecting the amplification products ;

- comparing the amplified products as obtained to the amplified products obtained with a normal control biological sample, and thereby detecting a possible abnormality in the transcript of the oligophrenin 1 gene.

30 18. Pharmaceutical composition comprising a purified oligophrenin 1 polypeptide of claim 4 and/or a homologous polypeptide thereof, or an isolated

nucleic acid sequence encoding said polypeptide in association with a pharmaceutically acceptable carrier

19. Pharmaceutical composition comprising an anti-sense sequence as defined in claim 7 or 8 in association with a pharmaceutically acceptable carrier.

20. Pharmaceutical composition comprising an antibody according to claim 11.

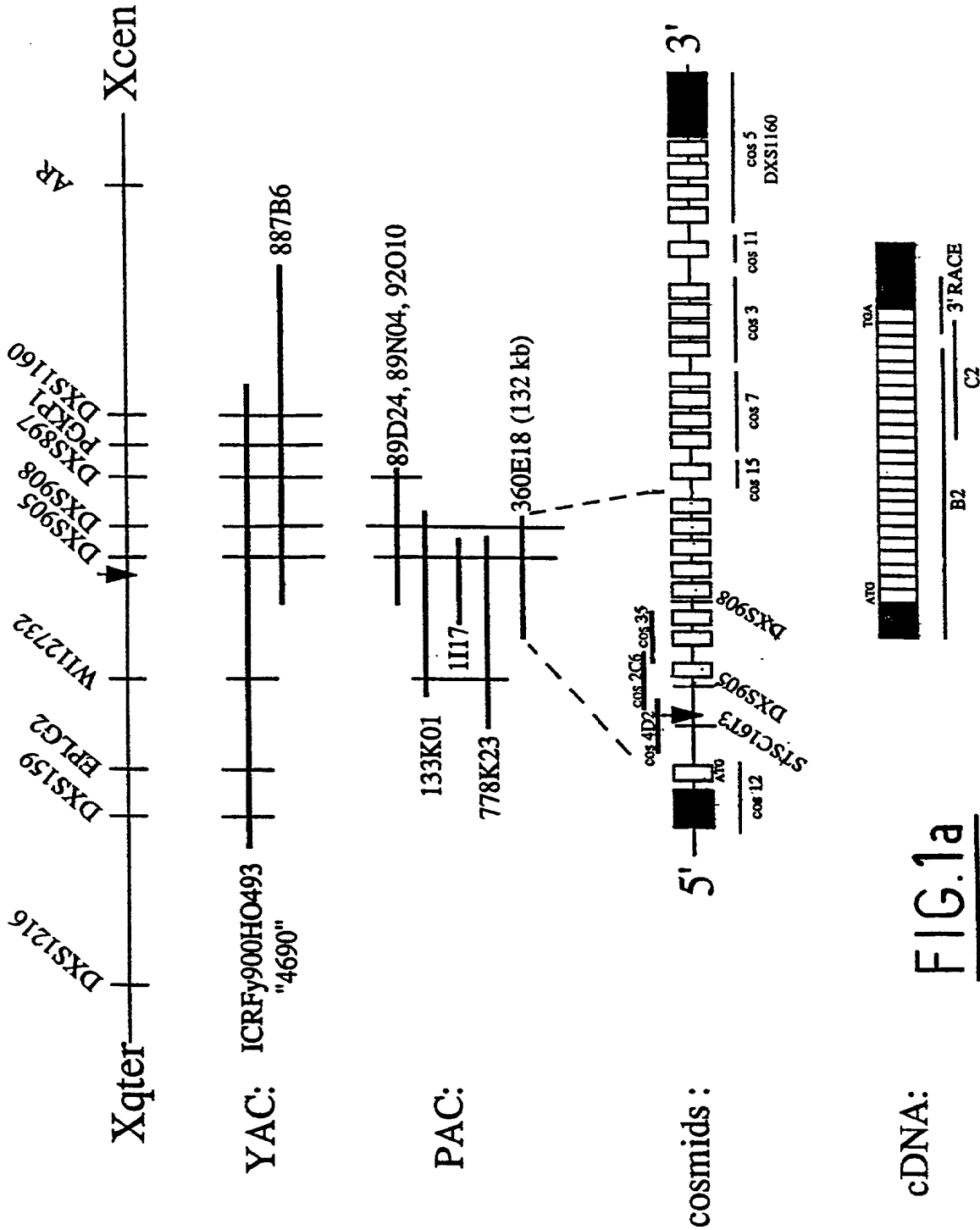
21. Transgenic non-human mammal expressing an exogenous oligophrenin 1 protein as defined in claim 4, or being modified so as to overexpress a native oligophrenin 1 protein as defined in claim 4, or so as to express a non-functional oligophrenin 1 protein as defined in claim 4.

22. Method for screening drugs likely to act on the signaling pathway to which the oligophrenin 1 protein belongs, wherein said drugs are tested on transgenic non-human mammals, or cells in culture, that overexpress oligophrenin 1 protein as defined in claim 4 or express a native oligophrenin 1 protein as defined in claim 4 that has been rendered non-functional.

23. Drug selected by the method of claim 22.

24. Pharmaceutical composition containing a drug of claim 23 in association with a pharmaceutically acceptable carrier.

25. Method of preventing and/or treating neurological disorders resulting from defects in the oligophrenin 1 gene or in the oligophrenin 1 protein or in a homologous gene or protein thereof, which comprises administering to a subject in need of a such treatment an amount of a pharmaceutical composition of claim 18 or 24 effective to prevent and/or alleviate said neurological disorders.



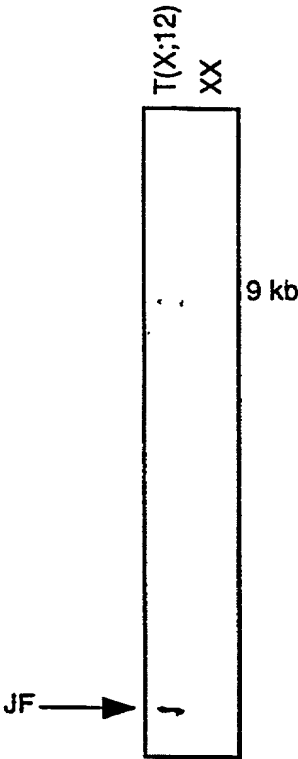
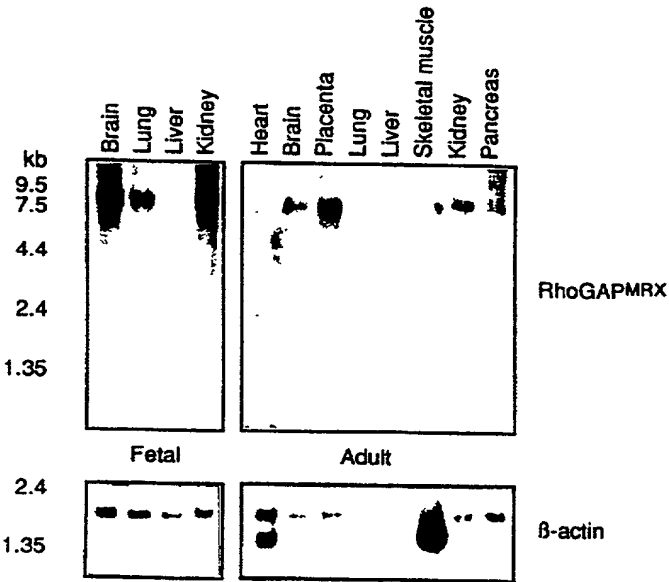


FIG. 1b

FIG. 2



tgtggtcgcgctctcgccctctctcccgctcgagtgctctatggagcgaggtacggttcattgccgcctcgcttaaaccttc	-553
cgcgccctaaaggacgcgccggtcccttgacacgaagaagtcttagcagccagcgggccctggtcaggaaactctagggtac	-461
aaggaaacagttgaggaaggacgcgtccggtttggtcctcggttcgctggcgggcgagcggttggcttttaagaaagggg	-369
agggacagtgcaatcggttgcccggttgcgcgaaggaattcgcgctcgctccgagcagagagcctgtaagagagctgtgtccacag	-277
ctccagcttaacctcgctacacctggcgcccaatgcaagcttgcaattgctcaggaagatccggcccgctgcggagggcaagt c	-185
gggtcgcggttttctgctctatctgggaaggcgtgcctaaaggacatgctgcttctgtaggcagcacccctcgcggtatccgactggatg	-193
ttagctcctcgccctgaagccatcgccggggtcgctgttctgtcggaagcagcgctcctcaggtctcactgaaacagaaacc	-1
ATG GGT CAT CCC CCG CTG GAG TTC AGC GAC TGC TAC CTG GAC AGC CCC GAT TTC CGC GAG AGG CTC AAG	69
M G H P P L E F S D C Y L D S P D F R E R L K	23
TGT TAT GAG CAG GAA CTG GAG AGG ACC AAC AAA TTC ATC AAA GAC GTA ATC AAA GAC GGC AAC GCG CTT	138
C Y E Q E L E R T N K F I K D V I K D G N A L	46
ATC AGC GCT ATG AGA AAT TAT TCT TCT GCT GGT CAG AAA TTT TCC CAG ACG CTG CAG TCA TTT CAG TTT	207
I S A M R N Y S S A V Q K F S Q T L Q S F Q F	69
GAT TTC ATT GGA GAC ACT CTG ACT GAT GAT GAA ATT AAC ATC GCT GAA TCC TTC AAG GAA TTT GCT GAA	276
D F I G D T L T D D E I N I A E S F K E F A E	92
TTG CTC AAC GAG GTA GAA AAT GAG AGG ATG ATG GTA CAC AAT GCT AGT GAT TTG CTG ATT AAA CCC	345
L L N E V E N E R M M V H N A S D L L I K P	115
TTG GAA AAT TTC CGG AAG GAA CAA ATA GGC TTC ACC AAG GAG CGG AAA AAG AAA TTT GAA AAG GAT GGT	414
L E N F R K E Q I G F T K E R K K K F E K D G	138
GAG AGG TTT TAT TCT TTA CTG GAT CGG CAC TTA CAC CTG TCT TCA AAA AAG AAA GAA TCT CAG TTA CAA	483
E R F Y S L L D R H L L S S K K K E S Q L Q	161
GCA GAC CTA CAG GTG GAG AAG GAG AGG CAC AAT TTT TTC GAG TCC TCT TCT GAT TAT GTT TAT CAA	552
E A D L Q V D K E R H N F F E S S L D Y V Y Y	184
ATC CAG GAA GTT CAG GAG TCC AAG AAG TTC AAT ATT GTG GAG CCT GTC TTG GCC TTT CTT CAT AGT CTG	621
I Q E V Q E S K K F N I V E P V L A F L H S L	207
TTT ATT TCT AAC AGC CTG ACT GTG GAG CTC ACA CAG GAT TTC CTC CCA TAC AAA CAA CAG CTC CAA CTC	690
F I S N S L T V E L T Q D F L P Y K Q L Q L	230
AGT TTA CAG AAT ACA AGA AAT CAT TTC TCC AGT ACC CGG GAA GAG ATG GAA GAA CTT AAG AAA AGG ATG	759
S L Q N T R N H F S S T R E E M E L K K R M	253
AAA GAA GCT CCC CAG ACA TGC AAA CTT CCA CGA CAG CCA ACT ATT GAA GGC TAT CTC TAT ACA CAA GAG	828
K E A P Q T C K L P G Q P T I E G Y L Y T Q E	276
AAA TGG GCT TTA GGA ATA TCC TGG GTG AAA TAC TAT TGC CAG TAT GAG AAA AAG ACC AAA ACA CTG ACC	897
K W A L G I S W V K Y Y C Q Y E K E T K T L T	299
ATG ATG CCT ATG CAG CAG AAG CCA GGT GCT AAG CAG GGG CCC TTG GAC TTA ACA CTG AAG TAC TGT GTG	966
M T P M E Q K P G A K Q G P L D L T L K Y C V	322
AGA AGG AAG ACG GAG TCT ATC GAC AAG AGG TTC TGT TTT GAC ATA GAA AAT AAT GAA AGG CCA GGA ACC	1035
R R K T E S I D K R F C F I E T N E R P G T	345
ATC ACT CTG CAG GCC CTT TCA GAA GCT AAC AGA AGG CTA TGG ATG GAA GCC ATG GAT GGG AAA GAA CCT	1104
I T L Q A L S E A N R R L W M E A M D G K E P	368

FIG. 3a

4/8

ATC TAC CAC AGC CCT ATA ACA AAA CAG CAA GAA ATG GAG CTA AAT GAA GTG GGC TTC AAG TTT GTC AGG 1173
 I Y H S P I T K Q Q E M E L N E V G F K F V R 391
 AAG TGC ATC AAT ATT GAG ACC AAA GGG ATC AAG ACA GAG TTG TAC CGC ACT GTG GGC AGC AAT 1242
 K C I N I I E T K K G I K T E G L Y R T V G S N 414
 ATT CAG GTT CAG AAG CTG CTG AAT GCC TTT TTT GAT CCT AAA TGC CCA GGA GAT GTT GAT TTT CAT AAT 1311
 I O V Q K L L N A F F D P K C P G D V D F H N 437
 AGT GAC TGG GAC ATT AAG ACA ATC ACC AGC TCC TTG AAA TTC TAC CTC AGG AAT CTT TCT GAA CCT GTC 1380
 S D W D I K T I T S S L K F Y L R N L S E P V 460
 ATG ACC TAT AGA CTT CAC AAA GAG CTG GTC TCT GCT GCC MAG TCT GAC AAC CTG GAT TAC CGC CTA GGA 1449
 M T Y R L H K E L V S A A K S D N L D Y R L G 483
 GCT ATT CAC TCC CTG GTA TAT AAG CTA CCA GAA AAG AAC CGA GAG ATG CTG GAA CTT CTG ATA AGA CAC 1518
 A I H S L V Y K L P E K N R E M L E L L I R H 506
 TTG GTC AAT GTG TGT GAG CAC AGC AAA GAG AAT CTT ATG ACC CCC TCC AAC ATG GGA GTA ATC TTT GGG 1587
 L V N V C E H S K E N L M T P S N M G V I F G 529
 CCC ACC CTG ATG AGA GCT CAG GAG GAC ACT GTG GCC GCT ATG ATG AAC ATC AAA TTC CAG AAC ATA GTG 1656
 P T L M R A Q E D T V A A M M N I K F Q N I V 552
 GTG GAA ATA CTA ATC GAG CAC TTT GGC AAG ATC TAT TTA GGT CCA CCT GAG GAA AGC GCT GCA CCG CCA 1725
 V E I L I E H F G K I Y L G P P E E S A A P P 575
 GTG CCT CGG CCT CGG GTG ACA GCA AGG CAC ACA ATC ACG ATT TCA AAG CGC TTG CTG CGA GAA 1794
 V P P P R V T A R H K P I T I S K R L L R E 598
 AGG ACG GTT TTC TAT ACT TCT TCC CTG GAT GAA AGC GAA GAT GAA ATC CAA CAT CAA ACA CCG AAT GGT 1863
 R T V F Y T S S L D E S E D E I Q H Q T P N G 621
 ACT ATC ACC AGC AGC ATA GAA CCC CCC AAG CCA CAA CAC CCC AAA CTA CCT ATT CAG AGG AGT GGG 1932
 T I T S S I E P P K P P Q H P K L P I Q R S G 644
 GAA ACT GAT CCT GGG AGG AAG TCC CCA AGC AGG CCT ATT TTG GAT GGC AAG TTG GAG CCC TGC CCA GAG 2001
 E T D P G R K S P S R P I L D G K L E P C P E 667
 GTG GAC GTG GGG AAG TTG GTG TCT AGG CTG CAG GAT GGA GGG ACC AAG ATC ACC CCA AAG GCC ACC AAT 2070
 V D V G K L V S R L Q D G G T K I T P K A T N 690
 GGA CCC ATG CCA GGC TCT GGG CCC ACC AAG ACC CCC TCT TTC CAC ATA AAG AGA CCA GCT CCC CGG CCC 2139
 G P M P G S G P T K T P S F H I K R P A P R P 713
 CTG GCC CAC CAC AAG GAG GGG GAT GCT GAC AGT TTC AGC AAA GTG CGG CCT CCA GGA AAG CCA ACC 2208
 L A H H K E G D A D S F S K V R P P G E K P T 736
 ATC ATC CGC CCC CCA GTG AGG CCC CCA GAT CCT CCC TGC CGG GCA GCT ACT CCC CAA AAG CCA GAA CCA 2277
 I I R P P V R P P D P P C R A TCA TCT GTG GTG GCT TCC AGG ACC AGG TTT 759
 AAG CCA GAT ATT GTG GCT GGC AAT GCG GGG GAA ATC ACA TCA TCT GTG GTG GCT TCC AGG ACC AGG TTT 2346
 K P D I V A G N A G E I T S S V V A S R T R F 782
 TTT GAA ACA GCT TCC CGG AAA ACA GGA AGT TCT CAA GGC AGA CTT CCT GGA GAT GAA AGT TGA ggctaca 2416
 F E T A S R K T G S S Q G R L P G D E S * 802
 gggttttaaaagccttgccctcagaggaccctttccaggttctgaag... 2463

FIG. 3a cont.

rhOGAP ^{MRX}	392
graf	197
CELZK328	69
Abx	672
B3cr	1086
NN-chimaerin	156
β -chimaerin	117
p190	1286
p85 α	128
consensus	

rrhoGAP^{MRX}
Graf
CELZK328
Abr
BBcr
NW-chimaerin
β-chimaerin
p190
p85α
consensus

rhogap MRX
graf
CELZK328
Abz
Bcr
NN-chimaerin
β-chimaerin
p190
p85α
consensus

FIG. 3b

॥ ॥ ॥ ॥

IHO G A P M R X
 C E L T 0 4 C 9 5
 E S T 4 8 3 2 1 0
 E S T 3 8 7 0 4 2
 C O N F I D E N T I A L

153
154
153
143

FIG. 3c

7/8

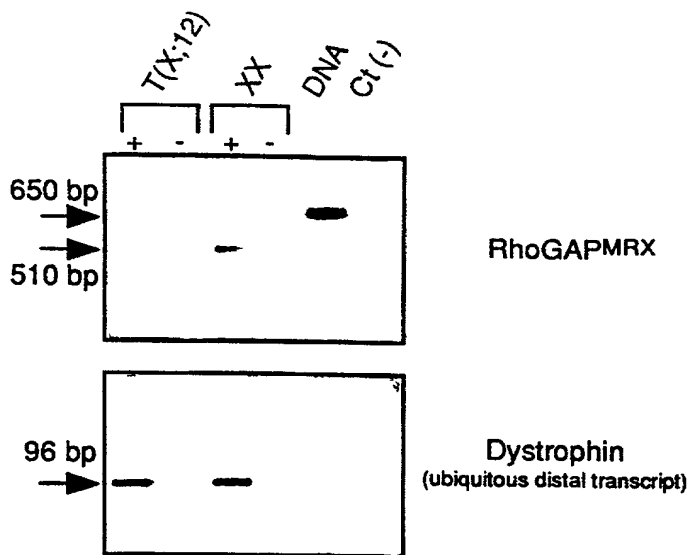


FIG. 4a

Val Ile Phe Gly Pro Thr Leu
 Wild-Type 5' CCC TCC AAC ATG GGA GT Δ ATC TTT GGG CCC ACC CTG 3'
 Val Ser Leu Gly Pro Pro STOP
 Mutant 5' CCC TCC AAC ATG GGA GTA TCT TTG GGC CCA CCC TGA 3'

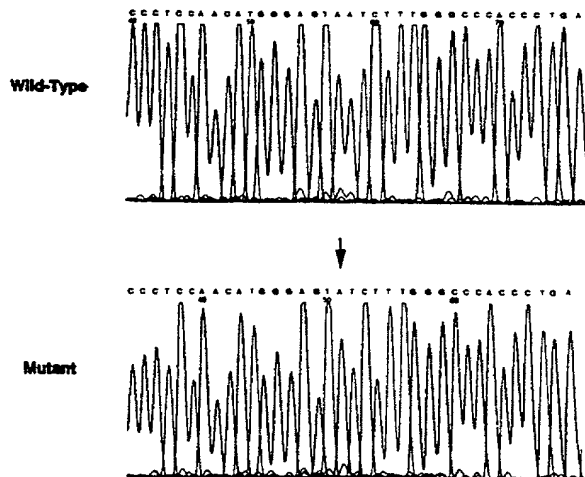


FIG. 4b

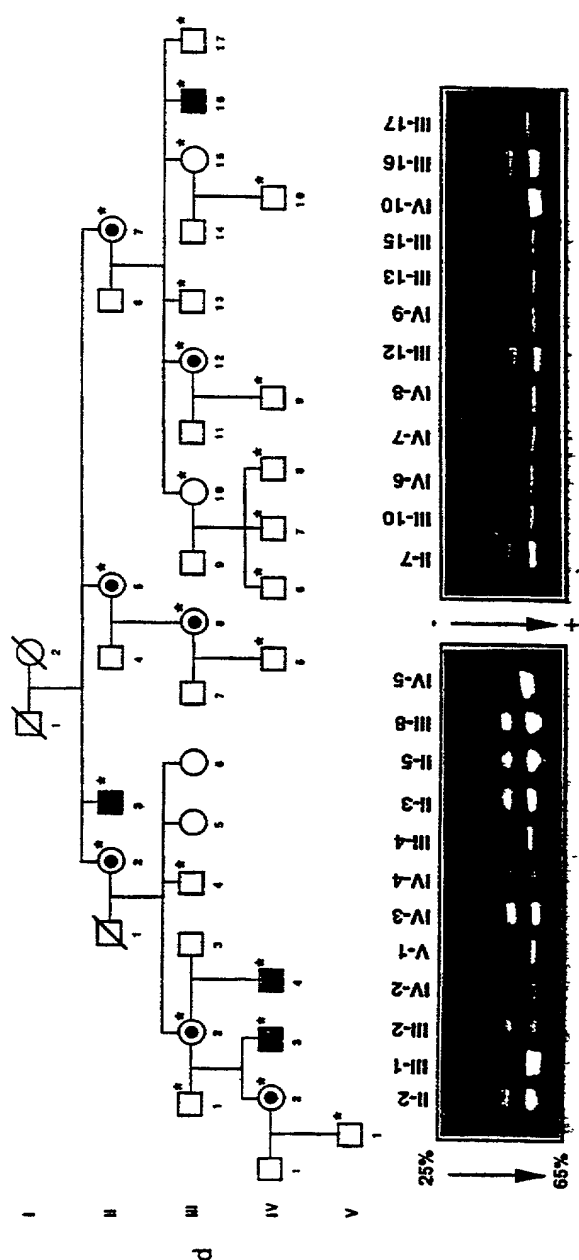


FIG. 4c

03 Rec'd PCT/13 21 NOV 2000

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patent

In re patent application of: CHELLY et al.

Serial No.: 09/581,422

Examiner:

Filed: June 13, 2000

Art Unit:

For: A NEW GENE CALLED OLIGOPHRENIN 1, ITS...

Atty. Docket No.:

P06780US0/BAS

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CUSTOMER NUMBER DESIGNATION

Honorable Assistant Commissioner for Patents

Washington, D.C.

S I R:

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Transpotomac Plaza
1199 North Fairfax Street
Suite 900
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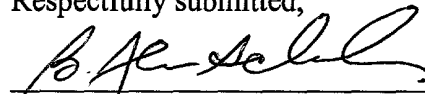
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Respectfully submitted,

Date: 21 November 2000


By: B. Aaron Schulman
Registration No.: 31,877

LARSON & TAYLOR, PLC • 1199 North Fairfax St. • Suite 900 • Alexandria, VA 22314

00727 22473550

15 NOV. 2000

ATTORNEY/DOCKET NO. _____

DECLARATION FOR PATENT APPLICATION AND APPOINTMENT OF ATTORNEY

As a below named inventor, I hereby declare that my residence, post office address and citizenship are as stated below next to my name; I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention (Design, if applicable) entitled "A new gene called oligophrenin 1, its expression product, and the diagnostic and therapeutic applications thereof".

the specification of which (check one):

- ☐ is attached hereto.
- ☒ was filed on June 13, 2000 as Application Serial No. 09/581,422,
and was amended on _____ (if applicable).
- ☐ was filed on 14/12/1998 as International Application (PCT) No. PCT/EP9808557,
and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment(s) referred to above. I acknowledge the duty to disclose information which is material to the examination of this application in accordance with *Rule 37, Code of Federal Regulations, §1.56(a)*. I hereby claim foreign priority benefits under *Rule 35, United States Code §119* of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

PRIOR FOREIGN APPLICATION(S)			PRIORITY CLAIMED	
97403050.4	EUROPE	December 15, 1997	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
Number	Country	Day/Month/Year Filed		
Number	Country	Day/Month/Year Filed	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Number	Country	Day/Month/Year Filed	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Number	Country	Day/Month/Year Filed	<input type="checkbox"/> Yes	<input type="checkbox"/> No

I hereby claim the benefit under *Rule 35, United States Code, §120* of any United States application(s) or PCT international application(s) designating The United States of America listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of *Rule 35, United States Code, §112*, I acknowledge the duty to disclose material information as defined in *Rule 37, Code of Federal Regulations, §1.56(a)* which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

Application Number	Filing Date	Status - Patented, Pending or Abandoned
Application Number	Filing Date	Status - Patented, Pending or Abandoned

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under *section 1001 of title 18 of the United States Code* and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: I (We) hereby appoint as my (our) attorneys, with full powers of substitution and revocation, to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: Andrew E. Taylor, Reg. 7000, Thomas P. Sarro 19396-Harold L. Novick 26011-Mark J. Gutttag 33057, Walter C. Gillis 22086, Ross L. Hunt Jr 25082, Douglas E. Jackson 28518, Daniel C. Mallery 33532, Marvin Petry 22752, William E. Jackson 4016, B. Aaron Schulman 31877

Send correspondence to: LARSON and TAYLOR - Transpotomac Plaza - 1199 North Fairfax street, suite 900 - Alexandria VIRGINIA 22314 - USA

Telephone Calls to: 703 920 7200.

☐ See following pages for additional joint inventors.

Full Name of First or Sole Inventor <u>CHÉLÉY JAMEL</u>	Citizenship <u>French</u>
Residence Address Street <u>11 rue Truillot</u>	Post Office Address Street
City <u>IVRY SUR SEINE</u>	City
State or Country <u>France</u> Zip <u>94200</u>	State or Country Zip
DATE <u>November 2, 2000</u>	SIGNATURE <u>[Signature]</u>

2-0

Full Name of Joint Inventor	BILLUART Pierre	Citizenship	French
Residence Address Street	5 rue Poliveau FRX	Post Office Address Street	
City	PARIS	City	Billuart
State or Country	FRANCE Zip 75005	State or Country	Zip
DATE	November 2, 2000	SIGNATURE	

3-0

Full Name of Joint Inventor	KAHN Axel	Citizenship	French
Residence Address Street	10 rue du Docteur Roux FRX	Post Office Address Street	
City	PARIS	City	
State or Country	FRANCE Zip 75015	State or Country	Zip
DATE	November 2, 2000	SIGNATURE	A Kahan

4-0

Full Name of Joint Inventor	BELDJORD Cherif	Citizenship	French
Residence Address Street	11 Bis rue Jacob Courant FRX	Post Office Address Street	
City	POISSY	City	
State or Country	France Zip 78300	State or Country	Zip
DATE	November 2, 2000	SIGNATURE	Cherif Beldjord

Full Name of Joint Inventor	Citizenship
Residence Address Street	Post Office Address Street
City	City
State or Country Zip	State or Country Zip
DATE	SIGNATURE

Full Name of Joint Inventor	Citizenship
Residence Address Street	Post Office Address Street
City	City
State or Country Zip	State or Country Zip
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